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(54) INK JET HEAD AND IMAGE FORMING APPARATUS

(57) An ink jet head (1) is provided with a head chip (4) and an ink manifold (2). The ink manifold (2) is provided with a supply port (14), a discharge port (15), an ink supply flow path (32), damper members (26 and 27), ink discharge flow paths (33 and 34), and partition walls (35 and 36). The ink supply flow path (32) is in communication with the supply port (14). The ink discharge flow paths (33 and 34) communicate with the discharge port (15) and allow passage of ink and air bubbles that have passed through a gap. The partition walls (35 and 36) restrict passage of the ink and the air bubbles on a side opposite to the gap at the damper members (26 and 27). Further, the ink manifold (2) restricts a flowing direction of the ink and the air bubbles to a direction from the ink supply flow path (32) to the ink discharge flow paths (33 and 34).

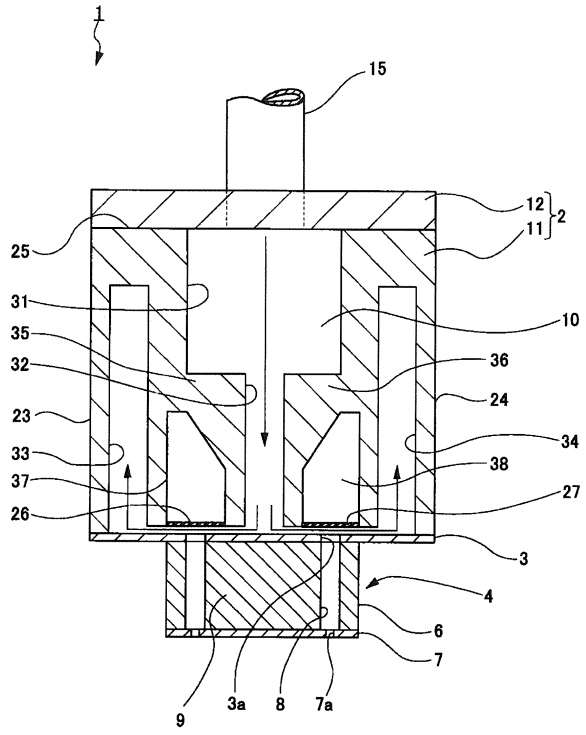

FIG. 3

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Description

Technological Field

[0001] The present invention relates to an ink jet head in which a common ink chamber is provided with a damper, and to an image forming apparatus having the ink jet head.

Background Art

[0002] Conventionally, high-resolution ink jet head using MEMS (Micro Electro Mechanical Systems) technology has been developed. The conventional ink jet head has plural channels to discharge ink. The ink jet head has a pressure chamber, an actuator to provide discharge pressure to ink supplied to the pressure chamber, and a nozzle plate with a nozzle hole to discharge the ink in the pressure chamber, by channel. Further, the ink jet head is provided with a common ink chamber to supply the ink to the pressure chamber.

[0003] Note that in the ink jet head, in some cases, the injection performance becomes nonuniform due to a pressure wave caused in the pressure chamber by driving of the actuator. The pressure wave caused by the driving in the pressure chamber is propagated to the pressure chambers of the other channels, communicated with each other, with the common ink chamber, to cause variation in the injection characteristic of the pressure wave-propagated pressure chamber, i.e., so-called crosstalk.

[0004] Conventionally, as a technique of reducing the influence among the pressure chambers due to crosstalk, e.g., a technique disclosed in Patent Literature 1 is known. Patent Literature 1 discloses a technique of providing a damper member in a common ink chamber. In the technique disclosed in this Patent Literature 1, the damper member having a flexible film is provided oppositely to an ink entrance of the pressure chamber, in the common ink chamber.

[0005] Fig. 28 is a cross-sectional diagram showing a conventional ink jet head.

[0006] As shown in Fig. 28, a conventional ink jet head 500 has an ink manifold 501 forming a common ink chamber, a substrate 502, a head chip 503, and a damper member 504 provided in an ink manifold chamber 501a. The head chip 503 is provided with plural channels 503a as pressure chambers and a nozzle plate. The ink manifold 501 is formed in a hollow approximately rectangular-parallelepiped shape, and opened in one surface.

[0007] The substrate 502 is provided so as to cover the opening of the ink manifold 501. The substrate 502 is provided between the ink manifold 501 and the head chip 503.

Further, plural through holes 502a which communicate with the channels 503a of the head chip 503 are formed in the substrate 502. The ink manifold 501 and the plural channels 503a of the head chip 503 communicate with each other via the through holes 502a of the substrate 502. The damper member 504 is provided so as to be opposite to the substrate 502 in the opening of the ink manifold 501.

Citation List

Patent Literature

[0008] PTL 1: Japanese Patent Application Laid-Open No. 2015-223737

Summary of Invention

Technical Problem

[0009] However, as shown in Fig. 28, the damper member 504 is provided close to the substrate 502 and the channels 503a of the head chip 503 so as to enhance the effect of pressure attenuation with the damper member 504. Accordingly, the flow path in a region PI between the damper member 504 and the head chip 503 under the damper member 504 is narrow.

[0010] Further, two ink flow paths divided with the damper member 504 join together again in this region P1. As a result, when remaining bubbles are mixed in the common ink chamber, the bubbles may easily remain in the region PI among the damper member 504, the substrate 502 and the head chip 503 under the damper member 504.

[0011] Further, in a region P2 in a side surface part of the damper member 504 and in a region P3 at a corner of the damper member 504 and in the chamber of the ink manifold 501, the flow speed is lower than that in other regions, and the bubbles easily remain. In this manner, as the bubbles remain around the damper member, the conventional ink jet head has a problem that the remained bubbles enter the pressure chamber to cause reduction of the injection performance.

[0012] In view of the above-described conventional problem, the present invention has an object to provide an ink jet head capable of efficiently removing bubbles remaining in a common ink chamber and an image forming apparatus having this ink jet head.

[Solution to Problem]

[0013] To solve the above-described problem, and to attain the object of the present invention, an ink jet head according to the present invention comprises a head chip having a plurality of pressure chambers, and an ink manifold having a common ink chamber that supplies ink to the head chip. The ink manifold has a supply port, a discharge port, an ink supply flow path, a damper member, an ink discharge flow path, and a partition wall. The supply port is provided with the ink. The discharge port discharges the ink and bubbles remaining in the ink. The ink supply flow path is provided in the inner space of the ink manifold. The ink supply flow path communicates with

the supply port. The ink passes through the ink supply port. The damper member is provided in the inner space. The damper member is provided to face an opening of the plurality of pressure chambers on the ink manifold side. The ink, having passed through the ink supply flow path, passes through a gap formed between the damper member and the head chip. The ink discharge flow path is provided in the inner space. The ink discharge flow path communicates with the discharge port. The ink and the bubbles, having passed through the gap, pass through the ink discharge flow path. The partition wall is provided in the inner space. The partition wall regulates passage of the ink and the bubbles in the damper member on the opposite side to the gap. The ink manifold limits a direction in which the ink and the bubbles flow in the gap to a direction from the ink supply flow path toward the ink discharge flow path.

[0014] Further, an image forming apparatus according to the present invention has the above-described ink jet head.

Advantageous Effects of Invention

[0015] According to the ink jet head and the image forming apparatus having the above-described configurations, it is possible to efficiently remove the bubbles remaining in the common ink chamber.

Brief Description of Drawings

[0016]

Fig. 1 is a schematic structural diagram showing an image forming apparatus according to a first embodiment of the present invention;
Fig. 2 is a perspective diagram showing an ink jet head according to the first embodiment of the present invention;
Fig. 3 is a cross-sectional diagram along a line A-A in Fig. 2;
Fig. 4 is a cross-sectional diagram along a line B-B in Fig. 2;
Fig. 5 is a plan view showing the ink jet head according to the first embodiment of the present invention, in which a cover member of an ink manifold is transparent;
Fig. 6 is a cross-sectional diagram showing the ink jet head according to a second embodiment of the present invention;
Fig. 7 is a cross-sectional diagram showing the ink jet head according to a third embodiment of the present invention;
Fig. 8 is a cross-sectional diagram along a line A-A in Fig. 7;
Fig. 9 is a plan view of the ink jet head according to the third embodiment of the present invention, in which the cover member of the ink manifold is transparent;
Fig. 10 is a perspective diagram showing the ink jet head according to a fourth embodiment of the present invention;
Fig. 11 is a cross-sectional diagram along a line A-A in Fig. 10;
Fig. 12 is a plan view showing the ink jet head according to a fifth embodiment of the present invention, in which the cover member of the ink manifold is transparent;
Fig. 13 is a cross-sectional diagram along a line A-A in Fig. 12;
Fig. 14 is a cross-sectional diagram along a line B-B in Fig. 12;
Fig. 15 is a cross-sectional diagram along a line C-C in Fig. 12;
Fig. 16 is a cross-sectional diagram along a line D-D in Fig. 12;
Fig. 17 is a plan view showing the ink jet head according to a sixth embodiment of the present invention, in which the cover member of the ink manifold is transparent;
Fig. 18 is a cross-sectional diagram along a line A-A in Fig. 17;
Fig. 19 is a cross-sectional diagram along a line B-B in Fig. 17;
Fig. 20 is a cross-sectional diagram along a line C-C in Fig. 17;
Fig. 21 is a cross-sectional diagram along a line D-D in Fig. 17;
Fig. 22 is a perspective diagram showing the ink jet head according to a seventh embodiment of the present invention, in which the cover member of the ink manifold is transparent;
Fig. 23 is a plan view showing the ink jet head according to the seventh embodiment of the present invention, in which the cover member of the ink manifold is transparent;
Fig. 24 is a cross-sectional diagram along a line A-A in Fig. 23;
Fig. 25 is a cross-sectional diagram along a line B-B in Fig. 23;
Fig. 26 is a cross-sectional diagram along a line C-C in Fig. 23;
Fig. 27 is a cross-sectional diagram showing another example of a head chip of the ink jet head according to the present invention; and
Fig. 28 is a cross-sectional diagram showing a conventional ink jet head.

Description of Embodiments

[0017] Hereinbelow, embodiments for implementation of an ink jet head and an image forming apparatus having the ink jet head according to the present invention will be described with reference to Figs. 1 to 27. Note that in the respective figures, corresponding elements have the same reference numerals. Further, the present invention is not limited to the following embodiments.

1. First Embodiment

1-1. Configuration of Image Forming Apparatus

[0018] First, the configuration of the image forming apparatus according to a first embodiment (hereinbelow, referred to as "present embodiment") of the present invention will be described with reference to Fig. 1.

[0019] Fig. 1 is a schematic structural diagram showing the image forming apparatus according to the present embodiment.

[0020] Note that in the following explanation, the conveyance direction of a recording medium R is a first direction X, and a direction orthogonal to the first direction X in the conveyance surface of the recording medium R is a second direction Y. Then a description will be made with a direction orthogonal to the first direction X and the second direction Y, i.e., an ink discharge direction (injection direction), as a third direction Z.

[0021] The apparatus shown in Fig. 1 is an image forming apparatus to form an image by discharging ink droplets toward the recording medium R. As shown in Fig. 1, the image forming apparatus 100 has a platen 101, two conveyance rollers 102, and 102, and plural line heads 103, 104, 105, and 106.

[0022] The platen 101 is formed in a flat plate shape. The recording medium R is placed on an upper surface of the platen 101. The conveyance rollers 102 are rotatably provided at both ends of the platen 101 in the first direction X. Then, when the conveyance rollers 102 are driven, the platen 101 conveys the recording medium R in the first direction X.

[0023] The line heads 103, 104, 105, and 106 are arrayed in parallel in the second direction Y, from one side in the first direction X, i.e., the upstream side in the conveyance direction of the recording medium R, to the other side in the first direction X, i.e., the downstream side in the conveyance direction of the recording medium R. The line heads 103, 104, 105, and 106 face the platen 101 in the third direction Z, with the recording medium R between the platen and the line heads.

[0024] Further, at least one ink jet head 1 to be described later (see Fig. 2) is provided inside the line heads 103, 104, 105, and 106. The line heads 103, 104, 105, and 106 discharge e.g. cyan (C), magenta (M), yellow (Y), and black (K) ink toward the recording medium R.

1-2. Configuration of Ink Jet Head

[0025] Next, the configuration of the ink jet head 1 will be described with reference to Figs. 2 to 5.

[0026] Fig. 2 is a perspective diagram showing the ink jet head 1. Fig. 3 is a cross-sectional diagram along a line A-A in Fig. 2. Fig. 4 is a cross-sectional diagram along a line B-B in Fig. 2. Fig. 5 is a plan view showing the ink jet head 1 in which a cover member 12 of an ink manifold 2 is transparent.

[0027] As shown in Fig. 2 and Fig. 3, the ink jet head 1 has the ink manifold 2, a substrate 3, and a head chip 4. The ink manifold 2 is formed in a hollow approximately rectangular-parallelepiped shape, and is opened in one surface. As shown in Fig. 3 and Fig. 4, the substrate 3 is provided so as to close the opening of the ink manifold 2. Note that the detailed configuration of the ink manifold 2 will be described later.

[0028] The substrate 3 is formed with e.g. glass, ceramics, silicon, synthetic resin or the like, in an approximately flat plate shape. Plural through holes 3a are formed in the substrate 3. The through holes 3a are formed through from one surface to the other surface in the substrate 3 along the third direction Z. The through holes 3a communicate with a common ink chamber 10 as inner space of the ink manifold 2. Further, the through holes 3a are formed in positions facing channels 8 provided in the head chip 4 to be described later. The through holes 3a communicate with the channels 8.

[0029] Further, unshown wirings, electrically connected to unshown electrodes provided on the head chip 4 to be described later, are formed on the substrate 3. Further, an unshown flexible wiring board, electrically connected to the wirings on the substrate 3, are connected to the outer edge of the substrate 3.

[0030] The head chip 4 is bonded to the surface of the substrate 3 on the opposite side to the surface where the ink manifold 2 is bonded. The head chip 4 has a pressure chamber forming plate 6 and a nozzle plate 7.

[0031] The pressure chamber forming plate 6 is formed in an approximately rectangular-parallelepiped shape. The pressure chamber forming plate 6 is provided with the plural channels 8 as pressure chambers. The plural channels 8 are formed through from one surface to the other surface in the pressure chamber forming plate 6 along the third direction Z. The plural channels 8 communicate with the common ink chamber 10 of the ink manifold 2 via the through holes 3a of the substrate 3.

[0032] The plural channels 8 are arrayed along the first direction X and the second direction Y. Among the plural channels 8, plural channels 8 arrayed along the second direction Y form one channel array. This channel array is provided in plural positions along the first direction X, to form plural channel arrays.

[0033] Note that the channel array (pressure chamber array) means a set of channels 8 (pressure chambers) which form a recording width of an image recorded with a predetermined width on the recording medium R upon one-directional relative movement between the ink jet head 1 and the recording medium R.

[0034] When, e.g. the ink jet head 1 is fixedly provided with respect to the recording medium R and image formation is performed while the recording medium R is being conveyed in the first direction X as shown in Fig. 1, the recording width is a width formed upon this conveyance of the recording medium R. The second direction Y as a channel array direction in the ink jet head 1 is not limited to the direction parallel to the recording width of the image formed with the recording medium R, but

may be a direction obliquely crossing the recording width.

[0035] Further, the relative movement between the ink jet head 1 and the recording medium R is not limited to the example as shown in Fig. 1 where the ink jet head 1 is fixedly provided and the recording medium R is conveyed. For example, it may be configured such that image formation is performed by scan-moving the ink jet head 1 along the width direction of the recording medium R, and the recording medium R is moved in a direction orthogonal to the scan-moving direction of the ink jet head 1 by one scan movement. Otherwise, it may be configured such that the recording medium R is fixedly provided, image formation is performed by scan-moving the ink jet head 1 along the width direction of the recording medium R, and the ink jet head 1 is moved in a direction orthogonal to the scan-moving direction by one scan movement.

[0036] Further, as shown in Fig. 2, the plural channels 8 are provided in positions facing damper members 26 and 27 provided in the ink manifold 2 to be described later, and not provided in positions not facing the damper members 26 and 27.

[0037] Further, in the pressure chamber forming plate 6, at least a part of partition walls 9 partitioning between adjacent channels 8 in each channel array is formed with a poling processed piezoelectric device. An unshown driving electrode is formed on both of the surfaces of the partition wall 9. The driving electrode is connected to the wiring on the substrate 3, and voltage is applied. Then the partition wall 9 is shear-deformed by application of a driving signal at a predetermined voltage to the driving electrode. With this configuration, the capacity of the channel 8 between the pair of partition walls 9 varies so as to expand and contract. As a result, pressure for discharge is applied to the ink supplied in the channel 8.

[0038] Further, in the pressure chamber forming plate 6, the nozzle plate 7 is bonded to the other surface on the opposite side to the surface in contact with the substrate 3. That is, the nozzle plate 7 is provided on the side where the ink is discharged from the channels 8 in the pressure chamber forming plate 6.

[0039] The nozzle plate 7 is formed in an approximately flat plate shape. Plural nozzles 7a are formed in the nozzle plate 7. The nozzles 7a are provided in positions facing the channels 8 provided in the pressure chamber forming plate 6 and communicate with the channels 8. The ink in the channel 8, to which the pressure for discharge has been applied by deformation of the partition walls 9, is discharged through the channel 8 from the nozzle 7a to the outside.

[Configuration of Ink Manifold 2]

[0040] Next, the configuration of the ink manifold 2 will be described.

[0041] As shown in Fig. 2 to Fig. 5, the ink manifold 2 is formed in a hollow approximately rectangular-parallelepiped shape, and is opened in one surface. Further, the ink manifold 2 has a container member 11 and the cover member 12.

[0042] Note that in the present example, the ink manifold 2 is configured with two members, the container member 11 and the cover member 12, however, the ink manifold is not limited to this configuration. It may be configured such that the container member 11 and the cover member 12 are integrated with each other.

[0043] The container member 11 is formed in a hollow approximately rectangular-parallelepiped shape, and is opened in one surface on the lower side in the third direction Z. The inner space of the container member 11 becomes the common ink chamber 10. As described above, the opening of the container member 11 is covered with the substrate 3. Further, the cover member 12 is provided on the other surface of the container member 11 on the opposite side to the surface where the opening is formed.

[0044] Further, the container member 11 has a front part 21, a rear part 22, a first side wall 23, a second side wall 24, and an upper surface part 25. The front part 21 is provided at an end of the container member 11 in the second direction Y. The rear part 22 faces the front part 21, and is provided at the other end of the container member 11 in the second direction Y.

[0045] The first side wall 23 approximately vertically continues from one end of the front part 21 in the first direction X, extends along the second direction Y, and is connected to one end of the rear part 22 in the first direction X. The second side wall 24 is provided to face the first side wall 23. The second side wall 24 approximately vertically continues from the other end of the front part 21 in the first direction X, extends along the second direction Y, and is connected to the other end of the rear part 22 in the first direction X.

[0046] The upper surface part 25 is provided in a position facing the opening of the container member 11. The upper surface part 25 is connected to the front part 21, the rear part 22, the first side wall 23 and the second side wall 24.

[0047] An ink reservoir 31, an ink supply flow path 32, a first ink discharge flow path 33, a second ink discharge flow path 34, a first partition wall 35, a second partition wall 36, a first damper chamber 37, a second damper chamber 38, and an ink discharge part 39, are provided in the inner space of the container member 11. Further, the first damper chamber 37 is provided with the first damper member 26, and the second damper chamber 38 is provided with the second damper member 27.

[0048] As shown in Fig. 3 and Fig. 5, the ink reservoir 31 is formed by opening the approximate center of the upper surface part 25 in the first direction X from one end in the second direction Y, along the second direction Y, to the vicinity of the other end in the second direction Y, by a predetermined length. The ink reservoir 31 protrudes from the upper surface part 25 along the third direction Z toward the lower side by a predetermined length. The ink reservoir 31 is supplied with ink from a supply port 14

to be described later. Further, in the ink reservoir 31, the ink supply flow path 32 communicates with the approximate center of the lower surface in the third direction Z, in the first direction X.

[0049] The ink supply flow path 32 extends from the ink reservoir 31, toward the lower side in the third direction Z, to the vicinity of the opening of the container member 11. Further, as in the case of the ink reservoir 31, the ink supply flow path 32 extends from one end of the container member 11 in the second direction Y to the vicinity of the other end in the second direction Y. The ink supplied to the ink reservoir 31 passes through the ink supply flow path 32. Further, the first damper chamber 37 is formed on one side of the ink supply flow path 32 in the first direction X, and the second damp chamber 38 is formed on the other side of the ink supply flow path 32 in the first direction X.

[0050] The first damper chamber 37 and the second damper chamber 38 are opened on the lower side in the third direction Z. The openings of the first damper chamber 37 and the second damper chamber 38 face the through holes 3a of the substrate 3 bonded to the ink manifold 2 and the channels 8 of the head chip 4. Further, in the first damper chamber 37 and the second damper chamber 38, the openings are positioned in the vicinity of the opening of the ink manifold 2.

[0051] The first damper member 26 is provided so as to cover the opening of the first damper chamber 37. The second damper member 27 is provided so as to cover the opening of the second damper chamber 38. Accordingly, the first damper member 26 and the second damper member 27 are provided in the vicinity of the opening of the ink manifold 2, and face the through holes 3a of the substrate 3 and the channels 8 of the head chip 4. Further, the inner spaces of the first damper chamber 37 and the second damper chamber 38 are tightly sealed with the first damper member 26 and the second damper member 27, and a gas such as air is enclosed.

[0052] The first damper member 26 and the second damper member 27 are configured with a synthetic resin film having flexibility such as PI (polyimide), LCP (liquid crystal polymer), PET (polyethylene terephthalate), PE (polyethylene), PP (polypropylene). Further, it is preferable that the thickness of the first damper member 26 and the second damper member 27 is 10 μm or thicker and 150 μm or thinner from the viewpoint of effective development of damper effect of buffering by attenuating a pressure wave.

[0053] Further, the inner pressure of the first damper chamber 37 and the second damper chamber 38 tightly sealed with the first damper member 26 and the second damper member 27 is controlled to a predetermined pressure. The inner pressure of the first damper chamber 37 and the second damper chamber 38 is reduced such that, e.g., it is 50 kPa or higher and lower than atmospheric pressure under a condition of a normal temperature and one atmospheric pressure. With this configuration, it is possible to suppress narrowing of the flow path, formed between the first damper member 26 and the second damper member 27 and the substrate 3, with the damper members, and to attain an excellent damper effect. Note that the atmospheric pressure is a barometric pressure which is one atmospheric pressure upon measurement under a condition of normal temperature and one atmospheric pressure.

[0054] In this manner, by forming the first damper chamber 37 and the second damper chamber 38, in which the first damper member 26 and the second damper member 27 are provided, integrally with the container member 11, it is possible to perform positioning of the first damper member 26 and the second damper member 27 with ease. Further, it is possible to perform attachment of the first damper member 26 and the second damper member 27 with ease.

[0055] Further, the first ink discharge flow path 33 is provided on one side of the first damper chamber 37 opposite to the ink supply flow path 32 in the first direction X. The first ink discharge flow path 33 is formed between the first side wall 23 and the first damper chamber 37. As shown in Fig. 4 and Fig. 5, the first ink discharge flow path 33 extends from one end to the vicinity of the other end of the container member 11 in the second direction Y. Further, the first ink discharge flow path 33 extends from the opening of the container member 11 to the vicinity of the upper surface part 25. The ink, having passed through the ink supply flow path 32 and having passed between the first damper member 26 and the substrate 3, flows through the first ink discharge flow path 33.

[0056] As shown in Fig. 3, the first ink discharge flow path 33 is opened from the lower side of the container member 11 in the third direction Z to the vicinity of the upper surface part 25 on the upper side in the third direction Z. Further, as shown in Fig. 4, a first ink discharge communication path 33a is formed in an upper part of the first ink discharge flow path 33 in the third direction Z at the other end in the second direction Y. The first ink discharge communication path 33a is formed through the upper surface part 25 vertically in the third direction Z. The first ink discharge communication path 33a communicates with the ink discharge part 39 to be described later.

[0057] Further, as shown in Fig. 3 and Fig. 5, the second ink discharge flow path 34 is provided on the other side of the second damper chamber 38 opposite to the ink supply flow path 32 in the first direction X. The second ink discharge flow path 34 is formed between the second side wall 24 and the second damper chamber 38. The second ink discharge flow path 34 extends from one end of the container member 11 in the second direction Y to the vicinity of the other end. Further, the second ink discharge flow path 34 extends from the opening of the container member 11 to the vicinity of the upper surface part 25. The ink, having passed through the ink supply flow path 32 and having passed between the second damper member 27 and the substrate 3, flows through the second ink discharge flow path 34.

[0058] As shown in Fig. 3, the second ink discharge flow path 34 is opened from the lower side of the container member 11 in the third direction Z to the vicinity of the upper surface part 25 on the upper side in the third direction Z. Further, a second ink discharge communication path 34a is formed in an upper part of the second ink discharge flow path 34 in the third direction Z at the other end in the second direction Y. The second ink discharge communication path 34a is formed through the upper surface part 25 vertically in the third direction Z. The second ink discharge communication path 34a communicates with the ink discharge part 39 to be described later.

[0059] Further, the ink discharge part 39 is provided at the other end of the upper surface part 25 in the second direction Y. In the upper surface part 25, the ink discharge part 39 is provided on the other side from the ink reservoir 31 in the second direction Y. The ink discharge part 39 is a concave part recessed from the upper surface part 25 toward the lower side in the third direction Z by a predetermined depth. The first ink discharge flow path 33 communicates with the ink discharge part 39 via the first ink discharge communication path 33a. Further, the second ink discharge flow path 34 communicates with the ink discharge part 39 via the second ink discharge communication path 34a. The ink, having passed through the first ink discharge flow path 33 and the second ink discharge flow path 34, flows through the ink discharge part 39.

[0060] Further, as shown in Fig. 3, the first partition wall 35, partitioning the first ink discharge flow path 33 from the ink supply flow path 32, is provided on the upper side of the first damper chamber 37 in the third direction Z. Further, the second partition wall 36, partitioning the second ink discharge flow path 34 from the ink supply flow path 32, is provided on the upper side of the second damper chamber 38 in the third direction Z. Accordingly, the ink flows through only the lower side of the first damper chamber 37 and second damper chamber 38 in the third direction Z.

[0061] The cover member 12 is formed in an approximate rectangular and approximate flat plate shape. Further, the cover member 12 is formed in a shape to cover the entire other surface of the container member 11. This cover member 12 is provided with the supply port 14 and a discharge port 15.

[0062] The supply port 14 is provided at one end of the cover member 12 in the second direction Y. The supply port 14 is formed in a cylindrical shape. A cylindrical hole 14a of the supply port 14 is formed through from one surface to the other surface of the cover member 12 along the third direction Z, and communicates with the ink reservoir 31 of the container member 11. The ink is supplied from the supply port 14 toward the ink reservoir 31 of the container member 11.

[0063] Further, the discharge port 15 is provided at the other end of the cover member 12 in the second direction Y. The discharge port 15 is formed in a cylindrical shape. A cylindrical hole 15a of the discharge port 15 is formed through from one surface to the other surface of the cover member 12 along the third direction Z, and communicates with the ink discharge part 39 of the container member 11. The ink and bubbles stored in the ink discharge part 39 of the container member 11 are discharged from the discharge port 15.

1-3. Flow of Ink and Bubbles

[0064] Next, the flow of the ink and the bubbles remaining in the ink, in the ink jet head 1 having the above-described configuration, will be described.

[0065] As shown in Fig. 2, Fig. 4 and Fig. 5, the common ink chamber 10 of the ink manifold 2 is supplied with the ink from the supply port 14. First, the ink supplied from the supply port 14 is stored in the ink reservoir 31. Then as shown in Fig. 3, the ink supplied to the ink reservoir 31 passes through the ink supply flow path 32, and flows from the center of the container member 11 in the first direction X toward the opening.

[0066] The ink, having passed through the ink supply flow path 32, and having flowed to the opening of the container member 11, is divided to one side and the other side in the second direction Y. Then the ink on the one side in the first direction X passes through a gap between first damper member 26 and the substrate 3, and flows from the center in the first direction X to the one side. Further, the ink on the other side in the first direction X passes through a gap between the second damper member 27 and the substrate 3, and flows from the center in the first direction X toward the other side.

[0067] Note that the upper side of the first damper member 26 and the second damper member 27 in the third direction Z is partitioned with the first partition wall 35 and the second partition wall 36. Accordingly, the flow of the ink passing the upper side of the first damper member 26 and the second damper member 27 in the third direction Z is regulated with the first partition wall 35 and the second partition wall 36. Accordingly, the ink passes through only the lower side of the first damper member 26 and the second damper member 27 in the third direction Z.

[0068] Then the flow of the ink in the first direction X passing through the first damper member 26 is only a flow from the center in the first direction X toward one side. Further, the flow of the ink in the first direction X passing through the second damper member 27 is only a flow from the first direction X toward the other side.

[0069] With this configuration, it is possible to push the bubbles remaining between the first damper member 26 and the second damper member 27 and the substrate 3 from the center in the first direction X to one side or the other side in the first direction X with the flow of the ink. As a result, it is possible to prevent the bubbles remaining between the first damper member 26 and the second damper member 27 and the substrate 3 from entering the channels 8 to lower the injection performance.

[0070] Further, the ink having passed through a gap between the first damper member 26 and the substrate 3 flows to the first ink discharge flow path 33. Further, the ink having passed through a gap between the second damper member 27 and the substrate 3 flows to the second ink discharge flow path 34. Note that the bubbles remaining in the lower part of the first damper member 26 in the third direction Z and in a side surface part on one side in the first direction X are pushed to the first ink discharge flow path 33 along the flow of the ink. Further, the bubbles remaining in the lower part of the second damper member 27 in the third direction Z and in a side surface part on the other side in the first direction X are pushed to the second ink discharge flow path 34 along the flow of the ink.

[0071] Further, as shown in Fig. 5, the ink flowed to the first ink discharge flow path 33 flows to the ink discharge part 39 via the first ink discharge communication path 33a. Then, the ink flowed to the second ink discharge flow path 34 flows to the ink discharge part 39 via the second ink discharge communication path 34a. Accordingly, the bubbles remaining in the ink are also made to pass through the first ink discharge flow path 33 and the second ink discharge flow path 34 along the flow of the ink, and pushed to the ink discharge part 39. Then the bubbles are discharged from the ink discharge part 39 via the discharge port 15 to the outside of the ink manifold 2.

[0072] In this manner, by limiting the flow of the ink supplied into the common ink chamber 10 as inner space of the ink manifold 2 such that it is directed to a predetermined direction, it is possible to efficiently remove the bubbles remaining in the ink.

[0073] Further, as shown in Fig. 3, the first ink discharge flow path 33 and the second ink discharge flow path 34 are opened to the upper side in the third direction Z. The ink discharge part 39 is provided in the upper part of the container member 11 in the third direction Z. In this manner, the first ink discharge flow path 33, the second ink discharge flow path 34, and the ink discharge part 39 are provided in a direction where the bubbles float up by their own buoyancy. As a result, it is possible to efficiently discharge the bubbles remaining in the ink.

2. Second Embodiment

[0074] Next, the ink jet head according to a second embodiment of the present invention will be described with reference to Fig. 6.

[0075] Fig. 6 is a cross-sectional diagram showing the ink jet head according to the second embodiment.

[0076] The difference between an ink jet head 1A according to the second embodiment and the ink jet head 1 according to the first embodiment is the configurations of the ink reservoir and the ink supply flow path. Accordingly, the ink reservoir and the ink supply flow path will be described here. The elements corresponding to those of the ink jet head 1 according to the first embodiment will have the same reference numerals, and overlapped explanations will be omitted.

[0077] As shown in Fig. 6, the ink jet head 1A has an ink manifold 2A, the substrate 3, and the head chip 4. An ink reservoir 31A and an ink supply flow path 32A are provided in inner space of a container member 11A of the ink manifold 2A. Further, the container member 11A has the first ink discharge flow path 33, the second ink discharge flow path 34, the first partition wall 35, the second partition wall 36, the first damper chamber 37, the second damper chamber 38, and the ink discharge part 39.

[0078] In a lower part of the ink reservoir 31A in the third direction Z, the interval in the first direction X is continuously widened in accordance with increase of distance from the ink supply flow path 32A. That is, a tapered member 31a in a tapered shape is provided in the lower part of the ink reservoir 31A in the third direction Z.

[0079] The tapered member 31a is provided with a filter 41. The filter 41 removes foreign substances remaining in the ink. Further, as the ink passes through the filter 41, the bubbles remaining in the ink are finely broken. With this configuration, it is possible to suppress reduction of the injection performance upon entrance of the bubbles in the channels 8. Further, as the tapered member 31a is provided with the filter 41, it is possible to widen the effective area of the filter 41.

[0080] As other constituent elements are the same as those of the ink jet head 1 according to the above-described first embodiment, the explanations of those elements will be omitted. It is possible with the ink jet head 1A having this configuration to obtain the same operations and effects as those obtained with the ink jet head 1 according to the above-described first embodiment.

3. Third Embodiment

[0081] Next, the ink jet head according to a third embodiment of the present invention will be described with reference to Fig. 7 to Fig. 9.

[0082] Fig. 7 is a cross-sectional diagram showing the ink jet head according to the third embodiment. Fig. 8 is a cross-sectional diagram along a line A-A in Fig. 7. Fig. 9 is a plan view in which the cover member is transparent.

[0083] As an ink jet head 1B according to the third embodiment, the shape of the first ink discharge flow path and the second ink discharge flow path in the ink jet head 1A according to the second embodiment is changed. Accordingly, the ink discharge flow paths will be described here. The elements corresponding to those of the ink jet head 1 according to the first embodiment and of the ink jet head 1A according to the second embodiment will have the same reference numerals, and overlapped explanations will be omitted.

[0084] As shown in Fig. 7 to Fig. 9, the ink jet head 1B has an ink manifold 2B, the substrate 3, and the head chip 4. The ink reservoir 31A and the ink supply flow path 32A are provided in inner space of a container member

11B of the ink manifold 2B. The ink reservoir 31A is provided with the filter 41.

[0085] Further, the container member 11B has a first ink discharge flow path 33B, a second ink discharge flow path 34B, the first partition wall 35, the second partition wall 36, the first damper chamber 37, the second damper chamber 38, and an ink discharge part 39B.

[0086] As shown in Fig. 8, the first ink discharge flow path 33B is inclined in a direction away from the opening of the container member 11B from one end toward the other end in the second direction Y. Accordingly, an upper surface part of the first ink discharge flow path 33B facing the head chip 44 in the third direction Z becomes away from the head chip 4 to the upper position in the third direction Z from the one end toward the other end in the second direction Y. That is, the upper surface part of the first ink discharge flow path 33B is inclined from the one end toward the ink discharge part 39B in the second direction Y. Note that the configuration of the second ink discharge flow path 34B is also the same as that of the first ink discharge flow path 33B, accordingly, the explanation of the path will be omitted.

[0087] According to the ink jet head 1B according to the third embodiment, the bubbles remaining in the ink flow, along the slopes of the first ink discharge flow path 33B and the second ink discharge flow path 34B, toward the ink discharge part 39B and the discharge port 15. As a result, it is possible to also discharge the bubbles remaining at one end away from the ink discharge part 39B and the discharge port 15 in the second direction Y, efficiently, from the ink discharge part 39B and the discharge port 15.

[0088] As other constituent elements are the same as those of the ink jet head 1 according to the first embodiment and the ink jet head 1A according to the second embodiment described above, the explanations of those elements will be omitted. It is possible with the ink jet head 1B having this configuration to obtain the same operations and effects as those obtained with the ink jet head 1 according to the first embodiment and the ink jet head 1A according to the second embodiment described above.

4. Fourth Embodiment

[0089] Next, the ink jet head according to a fourth embodiment of the present invention will be described with reference to Fig. 10 and Fig. 11.

[0090] Fig. 10 is a perspective diagram showing the ink jet head according to the fourth embodiment. Fig. 11 is a cross-sectional diagram along a line A-A in Fig. 10.

[0091] The difference between an ink jet head 1C according to the fourth embodiment and the ink jet head 1 according to the first embodiment is the configuration of the inner space of the container member and the configuration of the cover member. Accordingly, the container member and the cover member will be described here. The elements corresponding to those of the ink jet head 1 according to the first embodiment will have the same reference numerals, and overlapped explanations will be omitted.

[0092] As shown in Fig. 10 and Fig. 11, the ink jet head 1C has an ink manifold 2C, a substrate 3C, and a head chip 4C. The ink manifold 2C has a container member 11C and a cover member 12C.

[0093] The container member 11C is formed in a hollow approximate rectangular-parallelepiped shape, and is opened in surfaces on both sides in the third direction Z. The container member 11C has a front part 21C, a rear part 22C, a first side wall 23C, and a second side wall 24C.

[0094] Further, an ink supply flow path 52, an ink discharge flow path 53, a partition wall 55, and a damper chamber 57 are formed in the inner space of the container member 11C. The partition wall 55 is connected to the center of the front part 21C in the first direction X on the upper side in the third direction Z. The partition wall 55 extends from one end to the other end in the second direction Y, and is connected to the rear part 22C.

[0095] The damper chamber 57 is formed at a lower end of the partition wall 55 in the third direction Z. As in the case of the partition wall 55, the damper chamber 57 is continuously provided along the second direction Y from the front part 21C to the rear part 22C. The damper chamber 57 is provided with a damper member 58.

[0096] Accordingly, the inner space of the container member 11C is divided with the partition wall 55 and the damper chamber 57 into one side and the other side in the first direction X. As shown in Fig. 11, the one side in the first direction X in the inner space of the container member 11C becomes the ink supply flow path 52. Further, the other side in the first direction X in the inner space of the container member 11C becomes the ink discharge flow path 53.

[0097] Further, as shown in Fig. 10, a supply port 14C is provided on one side of the cover member 12C in the first direction X at one end in the second direction Y. The supply port 14C communicates with the ink supply flow path 52. Further, a discharge port 15C is provided on the other side of the cover member 12C in the first direction X at the other end in the second direction Y. The discharge port 15C communicates with the ink discharge flow path 53.

[0098] As shown in Fig. 11, in the ink jet head 1C according to the fourth embodiment, the ink passes from one end in the first direction X through a gap between the damper member 58 and the substrate 3C, and flows toward the other end in the first direction X.

[0099] Further, according to the ink jet head 1C according to the fourth embodiment, it is possible to provide the damper member 58 in the center in the first direction X, and widen the area rather than the damper members 26 and 27 according to the first embodiment. Accordingly, it is possible to provide, through holes 3aC provided in the substrate 3C and the channels 8C of the head chip 4C, in the center in the first direction X. As a result, the

number of channel arrays is larger than that of the ink jet head 1 according to the first embodiment.

[0100] As other constituent elements are the same as those of the ink jet head 1 according to the above-described first embodiment, the explanations of those elements will be omitted. It is possible with the ink jet head 1C having this configuration to obtain the same operations and effects as those obtained with the ink jet head 1 according to the above-described first embodiment.

5. Fifth Embodiment

[0101] Next, the ink jet head according to a fifth embodiment of the present invention will be described with reference to Fig. 12 to Fig. 16.

[0102] Fig. 12 is a plan view showing the ink jet head, in which the cover member of the ink manifold is transparent, according to the fifth embodiment. Fig. 13 is a cross-sectional diagram along a line A-A in Fig. 12. Fig. 14 is a cross-sectional diagram along a line B-B in Fig. 12. Fig. 15 is a cross-sectional diagram along a line C-C in Fig. 12. Fig. 16 is a cross-sectional diagram along a line D-D in Fig. 12.

[0103] The difference between the ink jet head 1D according to the fifth embodiment and the ink jet head 1 according to the first embodiment is the configuration of the inner space of the ink manifold. Accordingly, the container member of the ink manifold will be described here. The elements corresponding to those of the ink jet head 1 according to the first embodiment will have the same reference numerals, and overlapped explanations will be omitted.

[0104] As shown in Fig. 12 to Fig. 16, the ink jet head 1D has an ink manifold 2D, the substrate 3C, and the head chip 4C. The ink manifold 2C has a container member 11D and the cover member 12. Note that the configurations of the substrate 3C and the head chip 4C are the same as those of the substrate 3C and the head chip 4C according to the fourth embodiment, accordingly, the explanations of those configurations will be omitted.

[0105] The container member 11D is formed in an approximately rectangular-parallelepiped shape, and is opened in a surface on the lower side in the third direction Z. The container member 11D has a front part 21D, a rear part 22D, a first side wall 23D, a second side wall 24D, and an upper surface part 25D.

[0106] Further, an ink supply port 61, an ink supply flow path 62, an ink discharge flow path 63, a partition wall 65, a damper chamber 67, and an ink discharge port 69, are provided in the inner space of the container member 11D. As shown in Fig. 16, as in the case of the damper chamber 57 according to the fourth embodiment, the damper chamber 67 is continuously formed from one end to the other end of the container member 11D in the second direction Y. The damper chamber 67 is provided with a damper member 68.

[0107] As shown in Fig. 12 and Fig. 13, the ink supply port 61 is formed in the center of the upper surface part 25D in the first direction X at one end in the second direction Y. The ink supply port 61 is provided in an upper part of the damper chamber 67 in the third direction Z. The ink supply port 61 communicates with the supply port 14 provided in the cover member 12. Further, the ink supply port 61 also communicates with the ink supply flow path 62.

[0108] The ink supply flow path 62 is formed at one end in the first direction X at one end in the second direction Y, in the inner space of the container member 11D. The ink supply flow path 62 continues from the upper side to the opening on the lower side in the third direction Z, in the inner space of the container member 11D. The ink supply flow path 62 is formed on one side of the damper chamber 67 in the first direction X at one end in the second direction Y.

[0109] As shown in Fig. 12 and Fig. 14, the ink discharge port 69 is formed in the center of the upper surface part 25D in the first direction X at the other end in the second direction Y. The ink discharge port 69 is provided in the upper part of the damper chamber 67 in the third direction Z. The ink discharge port 69 communicates with the discharge port 15 provided in the cover member 12. Further, the ink discharge port 69 also communicates with the ink discharge flow path 63.

[0110] The ink discharge flow path 63 is formed at the other end in the first direction X at the other end in the second direction Y, in the inner space of the container member 11D. The ink discharge flow path 63 continues from the other side to the opening on the lower side in the third direction Z in the inner space of the container member 11D. The ink discharge flow path 63 is formed on the other side of the damper chamber 67 in the first direction x at the other end in the second direction Y.

[0111] As shown in Fig. 15, only the damper chamber 67 and the damper member 68 are provided in the intermediate part of the inner space of the container member 11D in the second direction Y. The both sides of the damper chamber 67 in the first direction X and the upper side in the third direction Z are covered with the partition wall 65.

[0112] In the ink jet head ID according to the fifth embodiment, the ink supplied from the supply port 14 passes through the ink supply port 61, formed immediately beneath the supply port 14, i.e. on the lower side in the third direction Z, enters the inner space of the container member 11D. Then the ink passes through the ink supply flow path 62, and flows through a gap between the damper member 68 and the substrate 3C.

[0113] Further, as shown in Fig. 16, the ink flows through the gap between the damper member 68 and the substrate 3C from one end toward the other end in the second direction Y. The ink having flowed to the other end in the second direction Y passes through the ink discharge flow path 63, and flows to the ink discharge port 69. Then the ink is discharged from the ink discharge port 69 to the discharge port 15.

[0114] In the ink jet head 1D according to the fifth em-

bodiment, the position to which the ink is supplied and the position from which the ink is discharged are limited to the positions immediately beneath the supply port 14 and the discharge port 15. With this configuration, in the ink jet head 1D according to the fifth embodiment, by limiting the ink flow direction more than in the ink jet head according to the first embodiment, it is possible to more efficiently discharge the bubbles from the discharge port 15.

[0115] As other constituent elements are the same as those of the ink jet head 1 according to the above-described first embodiment, the explanations of those elements will be omitted. It is possible with the ink jet head 1D having this configuration to obtain the same operations and effects as those obtained with the ink jet head 1 according to the above-described first embodiment.

[0116] Further, in the ink jet heads 1C and 1D according to the above-described fourth and fifth embodiments, it may be configured such that, as in the case of the ink jet heads 1A and 1B according to the second and third embodiments, a filter is provided between the supply port and the ink supply flow path.

6. Sixth Embodiment

[0117] Next, the ink jet head according to a sixth embodiment of the present invention will be described with reference to Fig. 17 to Fig. 21.

[0118] Fig. 17 is a plan view showing the ink jet head, in which the cover member of the ink manifold is transparent, according to the sixth embodiment of the present invention. Fig. 18 is a cross-sectional diagram along a line A-A in Fig. 17. Fig. 19 is a cross-sectional diagram along a line B-B in Fig. 17. Fig. 20 is a cross-sectional diagram along a line C-C in Fig. 17. Fig. 21 is a cross-sectional diagram along a line D-D in Fig. 17.

[0119] As an ink jet head 1E according to the sixth embodiment, in the ink jet head 1B according to the third embodiment, the flow path to supply ink to the common ink chamber is limited to one end in the second direction Y. Accordingly, the container member of the ink manifold will be described here. The elements corresponding to those of the ink jet head 1 according to the first embodiment and the ink jet head 1B according to the third embodiment will have the same reference numerals, and overlapped explanations will be omitted.

[0120] As shown in Fig. 17 to Fig. 21, the ink jet head 1 E has an ink manifold 2E, the substrate 3, and the head chip 4. An ink reservoir 71, an ink supply flow path 72, and a partition wall 75 are provided in the inner space of a container member 11E of the ink manifold 2E. The ink reservoir 71 is provided with the filter 41.

[0121] As shown in Fig. 17 and Fig. 18, the ink reservoir 71 is formed at one end of an upper surface part 25E in the second direction Y. Further, the ink reservoir 71 is formed in the center of the upper surface part 25E in the first direction X. The ink reservoir 71 communicates with the supply port 14 provided in the cover member 12. Further, the ink reservoir 71 also communicates with the ink supply flow path 72.

[0122] Further, the ink supply flow path 72 communicates with the ink reservoir 71 at one end in the second direction Y, and is formed in the inner space of the container member 11E to the opening on the lower side in the third direction Z. Further, as shown in Fig. 19 and Fig. 21, the ink reservoir 71 and the ink supply flow path 72 are formed only at one end of the container member 11E in the second direction Y.

[0123] Further, the container member 11E has a first ink discharge flow path 33E, a second ink discharge flow path 34E, the first damper chamber 37, the second damper chamber 38, and an ink discharge part 39E. Note that as shown in Fig. 20, the first ink discharge flow path 33E, the second ink discharge flow path 34E, the first damper chamber 37, the second damper chamber 38, and the ink discharge part 39E have the same configurations as those of the first ink discharge flow path 33B, the second ink discharge flow path 34E, the first damper chamber 37 the second damper chamber 38, and the ink discharge part 39B according to the third embodiment, accordingly, the explanations of the configurations will be omitted.

[0124] As shown in Fig. 19 and Fig. 21, the partition wall 75 partitions upper parts of the first damper chamber 37 and a second damper chamber 78 in the third direction Z. Further, the partition wall 75 also partitions the first damper chamber 37 from the second damper chamber 38, from an intermediate part to the other end of the container member 11E in the second direction Y.

[0125] With this configuration, the ink supplied from the supply port 14 is supplied via the ink reservoir 71 and the ink supply flow path 72, from one end of the container member 11E in the second direction Y to the inner space. Then, the ink having passed through the ink supply flow path 72 passes through a gap between the first damper member 26 or the second damper member 27 and the substrate 3, flows toward both sides in the first direction X, and flows from one side to the other side in the second direction Y. The ink passes through the first ink discharge flow path 33E and the second ink discharge flow path 34E, and is discharged from the ink discharge part 39E to the discharge port 15.

[0126] As other constituent elements are the same as those of the ink jet head 1 according to the above-described first embodiment, the explanations of those elements will be omitted. It is possible with the ink jet head 1 E having this configuration to obtain the same operations and effects as those obtained with the ink jet head 1 according to the above-described first embodiment and the ink jet head 1E according to the third embodiment.

7. Seventh Embodiment

[0127] Next, the ink jet head according to a seventh embodiment of the present invention will be described with reference to Fig. 22 to Fig. 26.

[0128] Fig. 22 is a perspective diagram showing the

ink jet head, in which the cover member of the ink manifold is transparent, according to the seventh embodiment. Fig. 23 is a plan view showing the ink jet head in which the cover member of the ink manifold is transparent. Fig. 24 is a cross-sectional diagram along a line A-A in Fig. 23. Fig. 25 is a cross-sectional diagram along a line B-B in Fig. 23. Fig. 26 is a cross-sectional diagram along a line C-C in Fig. 23.

[0129] The difference between an ink jet head 1F according to the seventh embodiment and the ink jet head 1 according to the first embodiment is that the position to supply ink and the position to discharge the ink. Accordingly, the container member will be described here. The elements corresponding to those of the ink jet head 1 according to the first embodiment will have the same reference numerals, and overlapped explanations will be omitted.

[0130] As shown in Fig. 22 to Fig. 26, the ink jet head 1F has an ink manifold 2F, the substrate 3, and the head chip 4. A container member 11F of the ink manifold 2F is formed in an approximately rectangular-parallelepiped shape, and is opened in a surface on the lower side in the third direction Z. The container member 11F has a front part 21F, a rear part 22F, a first side wall 23F, a second side wall 24F, and an upper surface part 25F.

[0131] Further, an ink reservoir 81, an ink supply flow path 82, a first ink discharge flow path 83, a second ink discharge flow path 84, a third ink discharge flow path 85, and a fourth ink discharge flow path 86, are provided in the inner space of the container member 11F. Further, a first damper chamber 87, a second damper chamber 88, a first common discharge flow path 89, a second common discharge flow path 90, an ink discharge part 91, and a partition wall 92, are provided in the inner space of the container member 11F.

[0132] As shown in Fig. 22, Fig. 23 and Fig. 24, the ink reservoir 81 is formed in the center of the upper surface part 25F in the first direction X. The ink reservoir 81 extends from one end to an intermediate part of the upper surface part 25F in the second direction Y. The ink reservoir 81 is a concave part recessed from the upper surface part 25F toward the lower side in the third direction Z by a predetermined length. The supply port 14 communicates with the ink reservoir 81.

[0133] As shown in Fig. 22 and Fig. 25, in the ink reservoir 81, an ink supply port 81a is opened in an intermediate part of the container member 11F in the second direction Y. The ink supply port 81a is formed by opening a lower surface of the ink reservoir 81 in the third direction Z. The ink supply flow path 82 communicates with the ink supply port 81a. Further, the ink supply port 81a is provided with a filter 93. As the filter 93 has the same configuration as that of the filter 41 according to the second embodiment, the explanation of the filter will be omitted.

[0134] The ink supply flow path 82 is continuously formed to the opening on the lower side in the third direction Z, in the center in the first direction X, in an intermediate part of the container member 11F in the second direction Y. The first damper chamber 87 is provided on one side of the ink supply flow path 82 in the first direction X. The second damper chamber 88 is provided on the other side of the ink supply flow path 82 in the first direction X. The first damper chamber 87 is provided with a first damper member 94. The second damper chamber 88 is provided with a second damper member 95.

[0135] The configurations of the first damper chamber 87, the second damper chamber 88, the first damper member 94, and the second damper member 95 are the same as those of the first damper chamber 37, the second damper chamber 38, the first damper member 26 and the second damper member 27 according to the first embodiment, the explanations of the configurations will be omitted.

[0136] As shown in Fig. 22, Fig. 23 and Fig. 24, the first ink discharge flow path 83 and the second ink discharge flow path 84 are provided at one end of the container member 11F in the second direction Y. The first ink discharge flow path 83 is formed on one side from the first damper chamber 87 in the first direction X. The second ink discharge flow path 84 is formed on the other side from the second damper chamber 88 in the first direction X. The first ink discharge flow path 83 and the second ink discharge flow path 84 are formed through from the opening of the container member 11F on the lower side to the upper surface part 25F on the upper side, in the third direction Z.

[0137] Further, as shown in Fig. 22, Fig. 23 and Fig. 26, the third ink discharge flow path 85 and the fourth ink discharge flow path 86 are provided at the other end of the container member 11F in the second direction Y. The third ink discharge flow path 85 is formed on one side from the first damper chamber 87 in the first direction X. The fourth ink discharge flow path 86 is formed on the other side from the second damper chamber 88 in the first direction X. The third ink discharge flow path 85 and the fourth ink discharge flow path 86 are formed through from the opening of the container member 11F on the lower side to the upper surface part 25F on the upper side, in the third direction Z.

[0138] As shown in Fig. 22 to Fig. 26, the first common discharge flow path 89 and the second common discharge flow path 90 are provided on both sides of the upper surface part 25F in the first direction X. The first common discharge flow path 89 is formed at one end of the upper surface part 25F in the first direction X. The first common discharge flow path 89 is a groove which continues from one end to the other end of the upper surface part 25F in the second direction Y. The first ink discharge flow path 83 communicates with one end of the first common discharge flow path 89 in the second direction Y. The third ink discharge flow path 85 communicates with the other end of the first common discharge flow path 89 in the second direction Y.

[0139] The second common discharge flow path 90 is formed at the other end of the upper surface part 25F in

the first direction X. The second common discharge flow path 90 is a groove which continues from one end to the other end of the upper surface part 25F in the second direction Y. The second ink discharge flow path 84 communicates with one end of the second common discharge flow path 90 in the second direction Y. The fourth ink discharge flow path 86 communicates with the other end of the second common discharge flow path 90 in the second direction Y.

[0140] As shown in Fig. 22 and Fig. 23, the ink discharge part 91 is provided at the other end of the upper surface part 25F in the second direction Y. The ink discharge part 91 is a concave part formed in an intermediate part of the upper surface part 25F in the first direction X, and recessed toward the lower side in the third direction Z by a predetermined length. The first common discharge flow path 89 and the second common discharge flow path 90 communicate with the ink discharge part 91. Further, the discharge port 15 communicates with the ink discharge part 91.

[0141] As shown in Fig. 24 and Fig. 25, the upper side of the first damper chamber 87 and the second damper chamber 88 in the third direction Z is partitioned with the partition wall 92. Further, as shown in Fig. 26, the partition wall 92 partitions the first damper chamber 87 from the second damper chamber 88 at the other end in the second direction Y.

[0142] As shown in Fig. 22 and Fig. 23, the ink jet head 1F according to the seventh embodiment, the ink supplied from the supply port 14 is first stored in the ink reservoir 81. The ink flows through the ink reservoir 81 from one end toward the intermediate part in the second direction Y, and as shown in Fig. 25, the ink flows from the ink supply port 81a to the ink supply flow path 82. The ink passes through the ink supply flow path 82, and flows to the opening of the container member 11 on the lower side in the third direction Z.

[0143] The ink having passed through the ink supply flow path 82 passes through a gap between the first damper member 94 and the second damper member 95 and substrate 3, and flows toward the four corners of the container member 11. The ink having flowed to the four corners of the container member 11 passes through the first ink discharge flow path 83, the second ink discharge flow path 84, the third ink discharge flow path 85 or the fourth ink discharge flow path 86, and flows to the first common discharge flow path 89 or the second common discharge flow path 90. Next, the ink flows via the first common discharge flow path 89 or the second common discharge flow path 90 to the ink discharge part 91, and is discharged from the ink discharge part 91 to the discharge port 15.

[0144] In this manner, in the ink jet head 1F according to the seventh embodiment, the ink is introduced from the center of the container member 11F, and the ink is caused to flow toward the four corners of the container member 11F. With this configuration, it is possible to remove unevenness of the ink at one end and the other end of the container member 11F in the second direction Y. Further, as the ink discharge flow paths 83, 84, 85 and 86 are provided at the four corners of the container member 11F, it is possible to efficiently discharge bubbles, which easily stay at the corners, to the ink discharge flow paths 83, 84, 85 and 86.

[0145] As other constituent elements are the same as those of the ink jet head 1 according to the above-described first embodiment, the explanations of those elements will be omitted. It is possible with the ink jet head 1F having this configuration to obtain the same operations and effects as those obtained with the ink jet head 1 according to the above-described first embodiment.

8. Another Example of Head Chip

[0146] Next, another example of the head chip in the ink jet head according to the present invention will be described with reference to Fig. 27.

[0147] Fig. 27 is a cross-sectional diagram showing another example of the head chip.

[0148] As shown in Fig. 27, an ink jet head 1G has the ink manifold 2, a holding member 203 covering the opening of the ink manifold 2, and a head chip 204. The holding member 203 is formed in an approximate flat plate shape, and has a through hole 203a which communicates with the common ink chamber 10 as the inner space of the ink manifold 2.

[0149] The head chip 204 is bonded to the holding member 203. The head chip 204 has a nozzle plate 210, an intermediate plate 220, a pressure chamber forming plate 230, a drive plate 240, and a wiring board 250. Further, the head chip 204 is formed by laminating the nozzle plate 210, the intermediate plate 220, the pressure chamber forming plate 230, the drive plate 240, and the wiring board 250, in this order, from the ink discharge surface side.

[0150] Plural nozzles 211 are formed in the nozzle plate 210. The nozzle 211 is formed through from one surface to the other surface of the nozzle plate 210. The nozzle 211 discharges ink supplied from the common ink chamber 10 to the outside. The nozzle 211 communicates with a pressure chamber 231 formed in the pressure chamber forming plate 230 via the intermediate plate 220 laminated on the nozzle plate 210.

[0151] The intermediate plate 220 is provided between the nozzle plate 210 and the pressure chamber forming plate 230. The intermediate plate 220 is provided with a first communication hole 221 for communication between the nozzles 211 and the pressure chamber 231 provided in the pressure chamber forming plate 230. The first communication hole 221 is provided in a position corresponding to the nozzle 211 of the nozzle plate 210, and is formed through from one surface to the other surface of the intermediate plate 220.

[0152] The pressure chamber forming plate 230 has plural pressure chambers (channels) 231 and a vibration plate 232. The pressure chamber 231 is formed through

from one surface to the other surface of the pressure chamber forming plate 230. With this pressure chamber 231, discharge pressure is applied to the ink discharged from the nozzle 211. Further, the pressure chamber 231 is provided in a position corresponding to the nozzle 211 of the nozzle plate 210 and the first communication hole 221 of the intermediate plate 220.

[0153] The vibration plate 232 is provided so as to cover the opening of the pressure chamber 231 on the opposite side to the intermediate plate 220. The vibration plate 232 is provided with a second communication hole 232a which communicates with the pressure chamber 231. The drive plate 240 is provided on one surface of the vibration plate 232 on the opposite side to one surface on the pressure chamber 231 side.

[0154] The drive plate 240 has space 241 and a third communication hole 242 which communicates with the second communication hole 232a. The space 241 is provided in a position facing the pressure chamber 231, with the vibration plate 232 between the space and the pressure chamber. An actuator 260 is accommodated in the space 241.

[0155] The actuator 260 has a piezoelectric device 261 and unshown two electrodes. The piezoelectric device 261 is provided between the two electrodes, and laminated on one surface of the vibration plate 232. The piezoelectric device 261 is provided by pressure chamber 231 (by channel).

[0156] The piezoelectric device 261 is formed with a material which is deformed by application of voltage, e.g., ferroelectric material such as lead zirconate titanate (PZT). Further, the electrode in the piezoelectric device 261 on the opposite side to the vibration plate 232 is connected with the wiring layer 251 provided on the wiring board 250.

[0157] The wiring board 250 has a wiring layer 251 and a silicon layer 252 where the wiring layer 251 is formed on one surface. The wiring layer 251 is connected to the electrodes of the actuator 260. Further, the outer edge of the wiring layer 251 is connected to an unshown flexible wiring board. Further, the silicon layer 252 is provided on one surface of the wiring layer 251 on the opposite side to the drive plate 240. The silicon layer 252 is bonded to the holding member 203.

[0158] Further, the wiring board 250 is provided with a fourth communication hole 253 formed through the wiring layer 251 and the silicon layer 252. The fourth communication hole 253 communicates with the common ink chamber 10 via the third communication hole 242 of the drive plate 240 and the through hole 203a of the holding member 203.

[0159] With this configuration, the ink having passed through the fourth communication hole 253, the third communication hole 242, and the second communication hole 232a, and been accommodated in the common ink chamber 10, flows into the pressure chamber 231. Then upon application of voltage to the actuator 260, the piezoelectric device 261 is deformed, and in accordance with the deformation of the piezoelectric device 261, the vibration plate 232 is deformed. The deformation of the vibration plate 232 causes pressure to discharge the ink in the pressure chamber 231. With this configuration, the ink is discharged via the first communication hole 221 from the nozzle 211.

[0160] As other constituent elements are the same as those of the ink jet head 1 according to the above-described first embodiment, the explanations of those elements will be omitted. It is possible with the ink jet head 1G, provided with the head chip 204 having this configuration, to obtain the same operations and effects as those obtained with the ink jet head 1 according to the above-described first embodiment.

[0161] Note that the present invention is not limited to the embodiments as described above and illustrated in the figures, but various modifications can be made without departing from the scope and spirit of the invention described in the claims.

List of Reference Signs

[0162] 1, 1A, 1B, 1C, 1D, 1E, 1F, 1G ... ink jet head; 2, 2A, 2B, 2C, 2D, 2E, 2F ... ink manifold; 3 ... substrate; 3a ... through hole; 4 ... head chip; 6 ... pressure chamber forming plate; 7 ... nozzle plate; 7a ... nozzle; 8 ... channel (pressure chamber); 10 ... common ink chamber; 11, 11, 11B, 11C, 11D, 11E, 11F ... container member; 12, 12C ... cover member; 14 ... supply port; 15 ... discharge port; 21 ... front part; 22 ... rear part; 23 ... first side wall; 24 ... second side wall; 25 ... upper surface part; 26 ... first damper member; 27 ... second damper member; 31 ... ink reservoir; 31a ... tapered member; 32 ... ink supply flow path; 33 ... first ink discharge flow path; 33a ... first ink discharge communication path; 34 ... second ink discharge flow path; 34a ... second ink discharge communication path; 35 ... first partition wall; 36 ... second partition wall; 37 ... first damper chamber; 38 ... second damper chamber; 39 ... ink discharge part; 41, 93 ... filter; 85 ... third ink discharge flow path; 86 ... fourth ink discharge flow path; 89 ... first common discharge flow path; 90 ... second common discharge flow path; 100 ... image forming apparatus; 101 ... platen; 102 ... conveyance roller; 103, 104, 105, 106 ... line head; 203 ... holding member; 203a ... through hole; 204 ... head chip; 210 ... nozzle plate; 211 ... nozzle; 220 ... intermediate plate; 230 ... pressure chamber forming plate; 231 ... pressure chamber; 232 ... vibration plate; 240 ... drive plate; 241 ... space; 250 ... wiring board; 251 ... wiring layer; 252 ... silicon layer; 260 ... actuator; 261 ... piezoelectric device.

Claims

1. An ink jet head comprising:

   a head chip having a plurality of pressure chambers; and

an ink manifold having a common ink chamber that supplies ink to the head chip,
wherein the ink manifold has:

a supply port to which the ink is supplied;
a discharge port from which the ink and bubbles remaining in the ink are discharged;
an ink supply flow path, which is provided in inner space of the ink manifold, which communicates with the supply port, and through which the ink passes;
a damper member, which is provided in the inner space, which is provided to face an opening of the plurality of pressure chambers on the ink manifold side, and in which the ink, having passed through the ink supply flow path, passes through a gap formed between the damper member and the head chip;
an ink discharge flow path which is provided in the inner space, which communicates with the discharge port, and which the ink and the bubbles having passed through the gap pass through; and
a partition wall which is provided in the inner space, and which regulates passage of the ink and the bubbles in the damper member on the opposite side to the gap, and

the ink manifold limits a direction in which the ink and the bubbles flow in the gap to a direction from the ink supply flow path toward the ink discharge flow path.

2. The ink jet head according to claim 1, wherein the damper member is provided in a damper chamber integrally formed with the ink manifold.

3. The ink jet head according to claim 1 or 2, wherein the ink supply flow path is provided in the center of the ink manifold in a first direction orthogonal to a discharge direction in which the ink is discharged to the head chip,
the damper member has: a first damper member provided on one side of the ink supply flow path in the first direction; and a second damper member provided on the other side of the ink supply flow path in the first direction, and
the ink discharge flow path has: a first ink discharge flow path provided on one side of the first damper member in the first direction; and a second ink discharge flow path provided on the other side of the second damper member in the first direction.

4. The ink jet head according to claim 3, wherein the supply port is provided at one end of the ink manifold in a second direction orthogonal to the discharge direction and also orthogonal to the first direction,
the discharge port is provided at the other end of the ink manifold in the second direction, and
an upper surface part of the first ink discharge flow path and the second ink discharge flow path in the discharge direction, facing the head chip, is away from the head chip in the discharge direction from one end toward the other end in the second direction.

5. The ink jet head according to claim 4, wherein the ink supply flow path is provided at one end of the ink manifold in the second direction.

6. The ink jet head according to claim 3, wherein the supply port is provided at one end of the ink manifold in a second direction orthogonal to the discharge direction and also orthogonal to the first direction,
the discharge port is provided at the other end of the ink manifold in the second direction,
the ink supply flow path is provided in the center of the ink manifold in the second direction,
the first ink discharge flow path is provided at one end of the ink manifold in the first direction and at one end in the second direction,
the second ink discharge flow path is provided at the other end of the ink manifold in the first direction and at one end in the second direction,
the ink discharge flow path further has:

a third ink discharge flow path provided at one end of the ink manifold in the first direction and at the other end in the second direction; and
a fourth ink discharge flow path provided at the other end of the ink manifold in the first direction and at the other end in the second direction, and
the ink manifold has:

a first common discharge flow path which connects the first ink discharge flow path to the third ink discharge flow path; and
a second common discharge flow path which connects the second ink discharge flow path to the fourth ink discharge flow path.

7. The ink jet head according to claim 1 or 2, wherein the ink supply flow path is provided at one end of the ink manifold in a first direction orthogonal to a discharge direction in which the ink is discharged to the head chip,
the ink discharge flow path is provided at the other end of the ink manifold in the first direction, and
the damper member is provided in the center in the first direction.

8. The ink jet head according to claim 7, wherein the supply port is provided at one end of the ink manifold in a second direction orthogonal to the discharge direction and also orthogonal to the first direction,

the discharge port is provided at the other end of the ink manifold in the second direction,
the ink supply flow path is provided at one end of the ink manifold in the second direction, and
the ink discharge flow path is provided at the other end of the ink manifold in the second direction.

9. The ink jet head according to any one of claims 1 to 8, wherein a filter is provided between the ink supply flow path and the supply port.

10. An image forming apparatus having the ink jet head according to any one of claims 1 to 9.

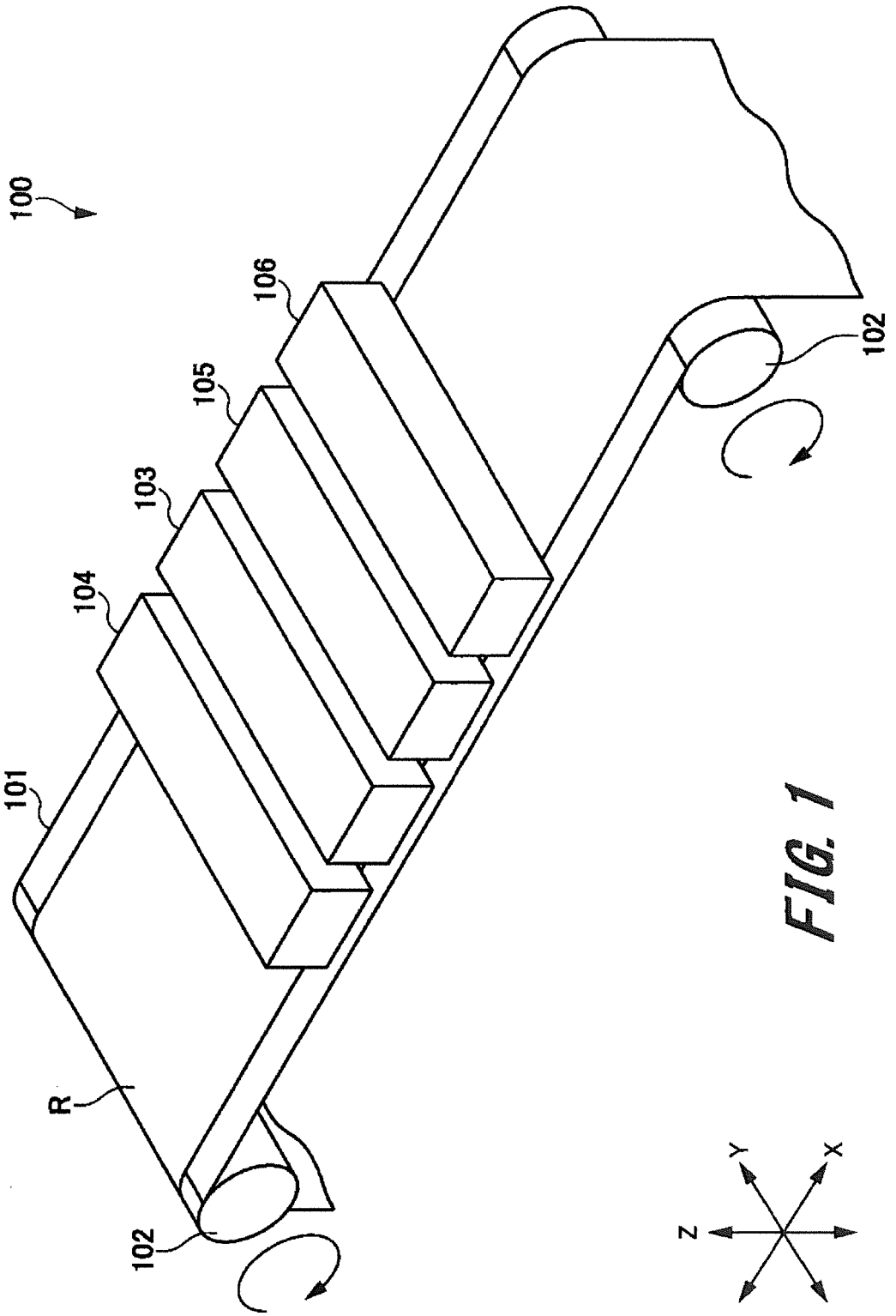


FIG. 1

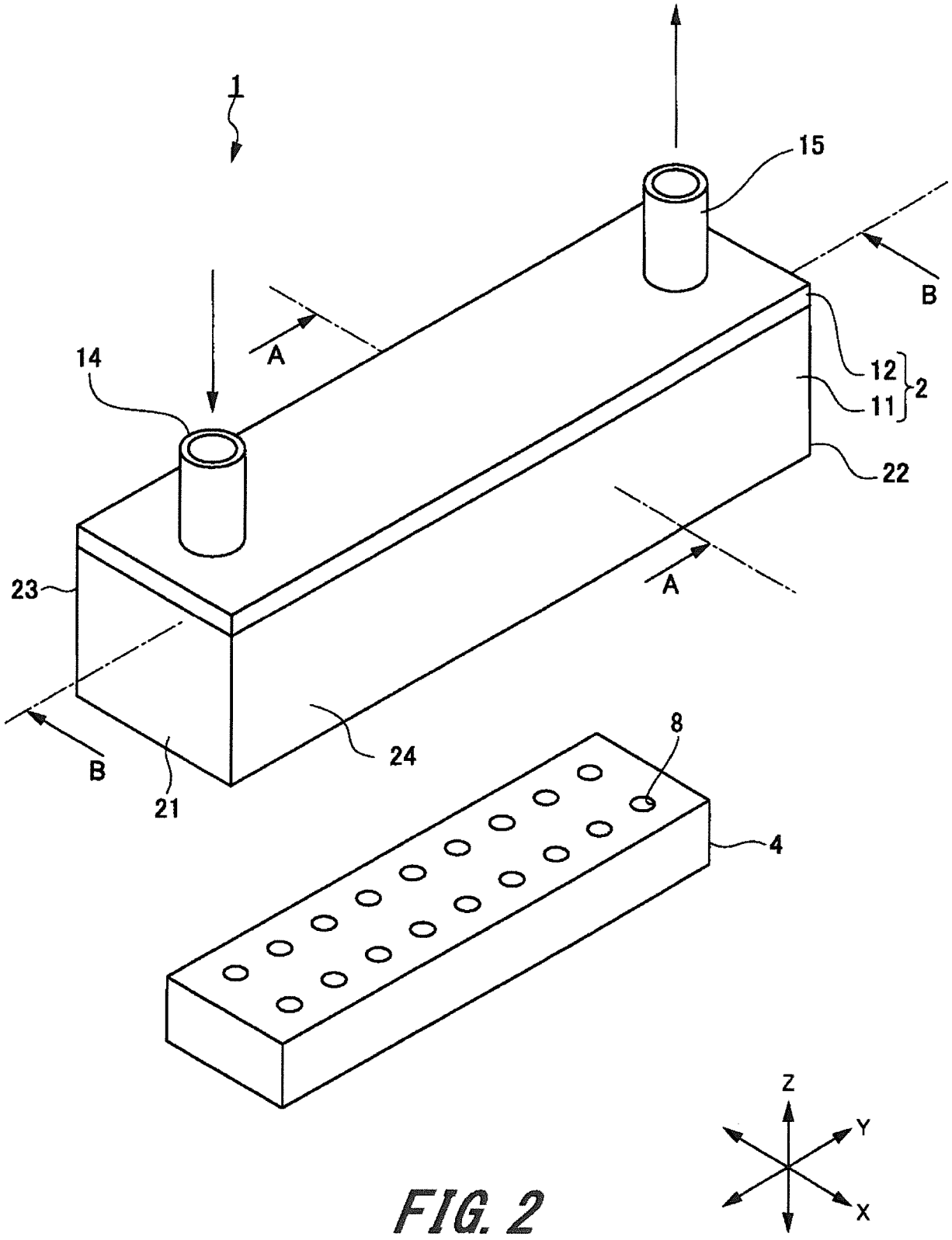


FIG. 2

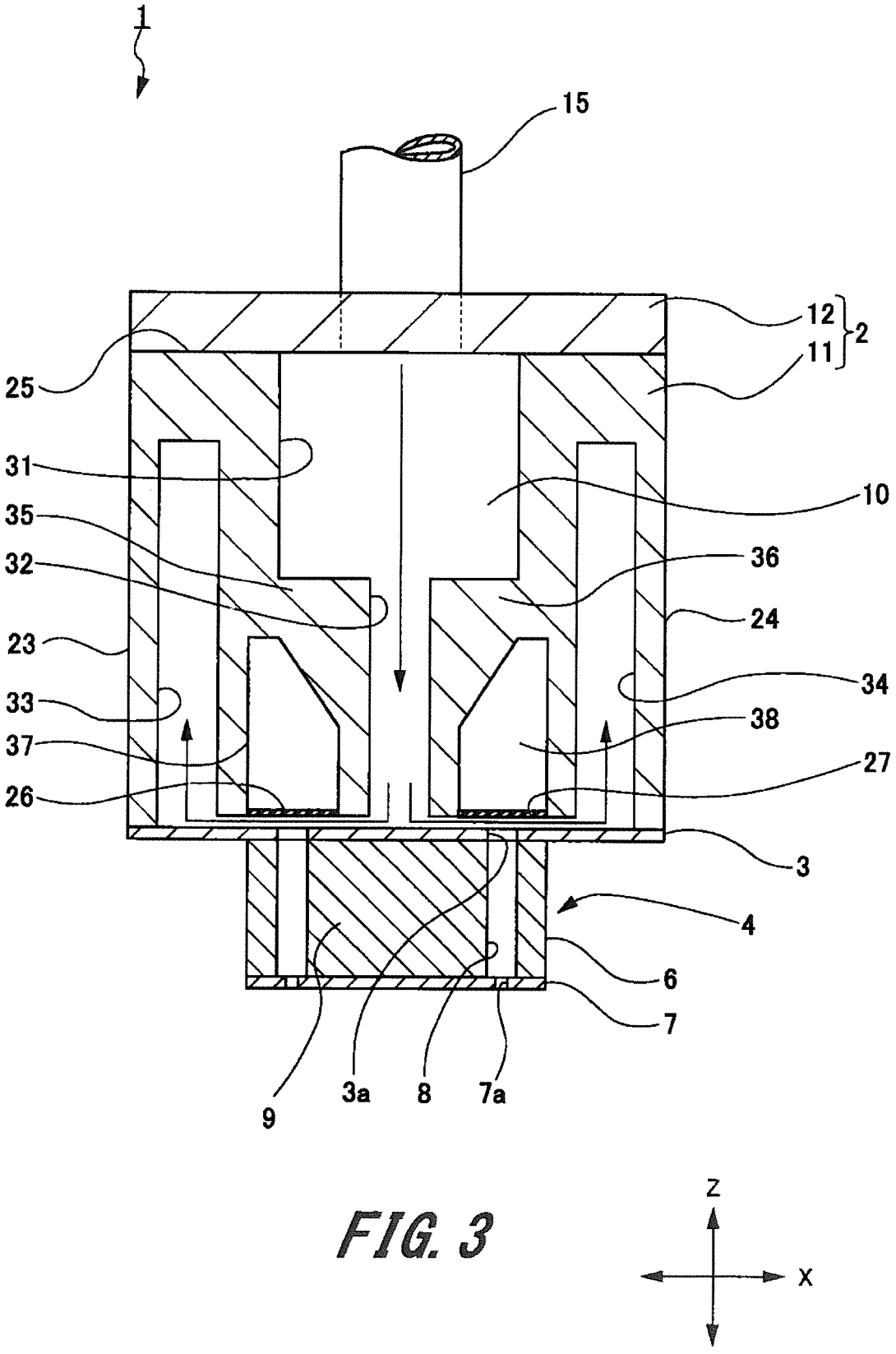


FIG. 3

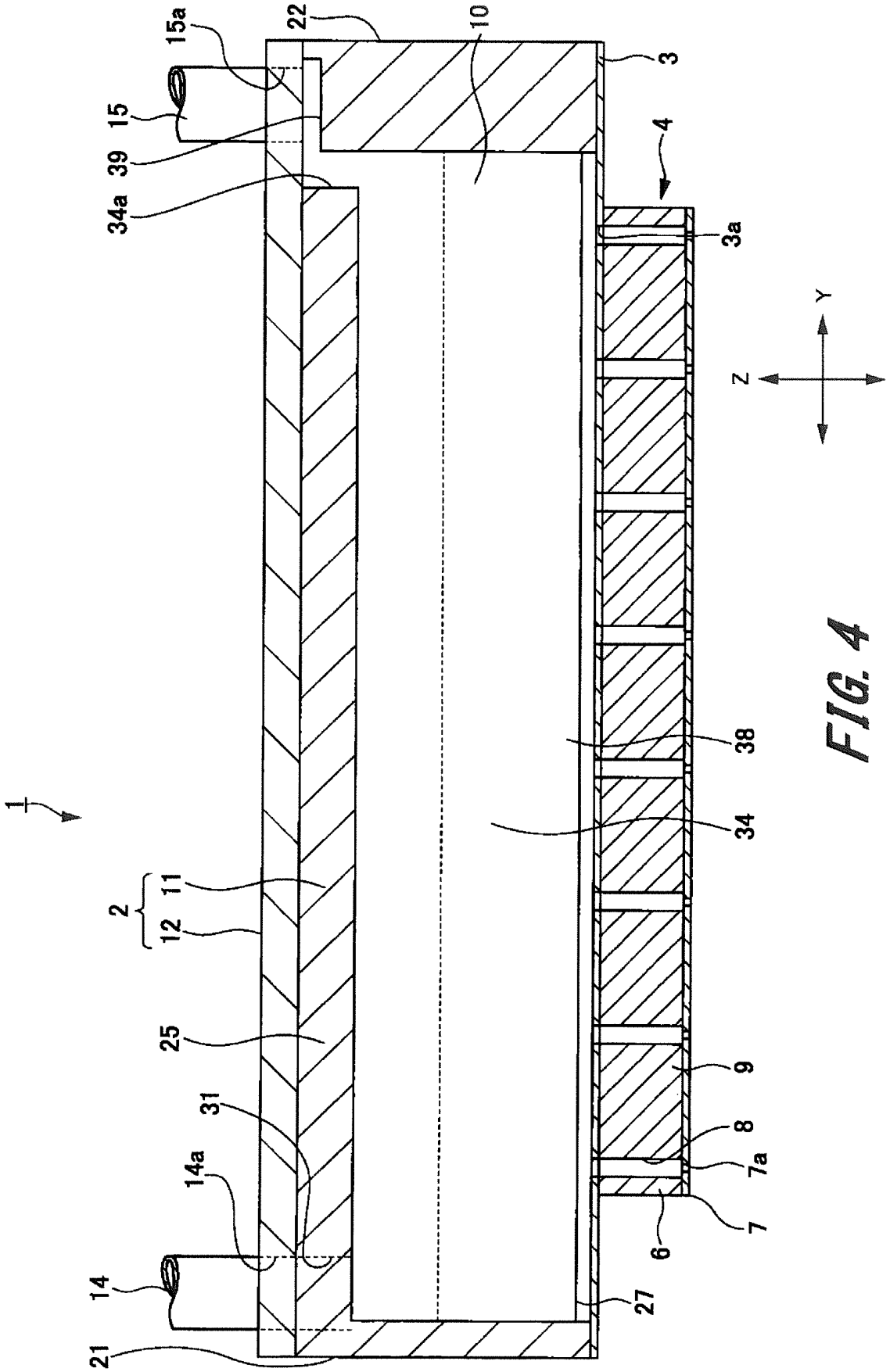


FIG. 4

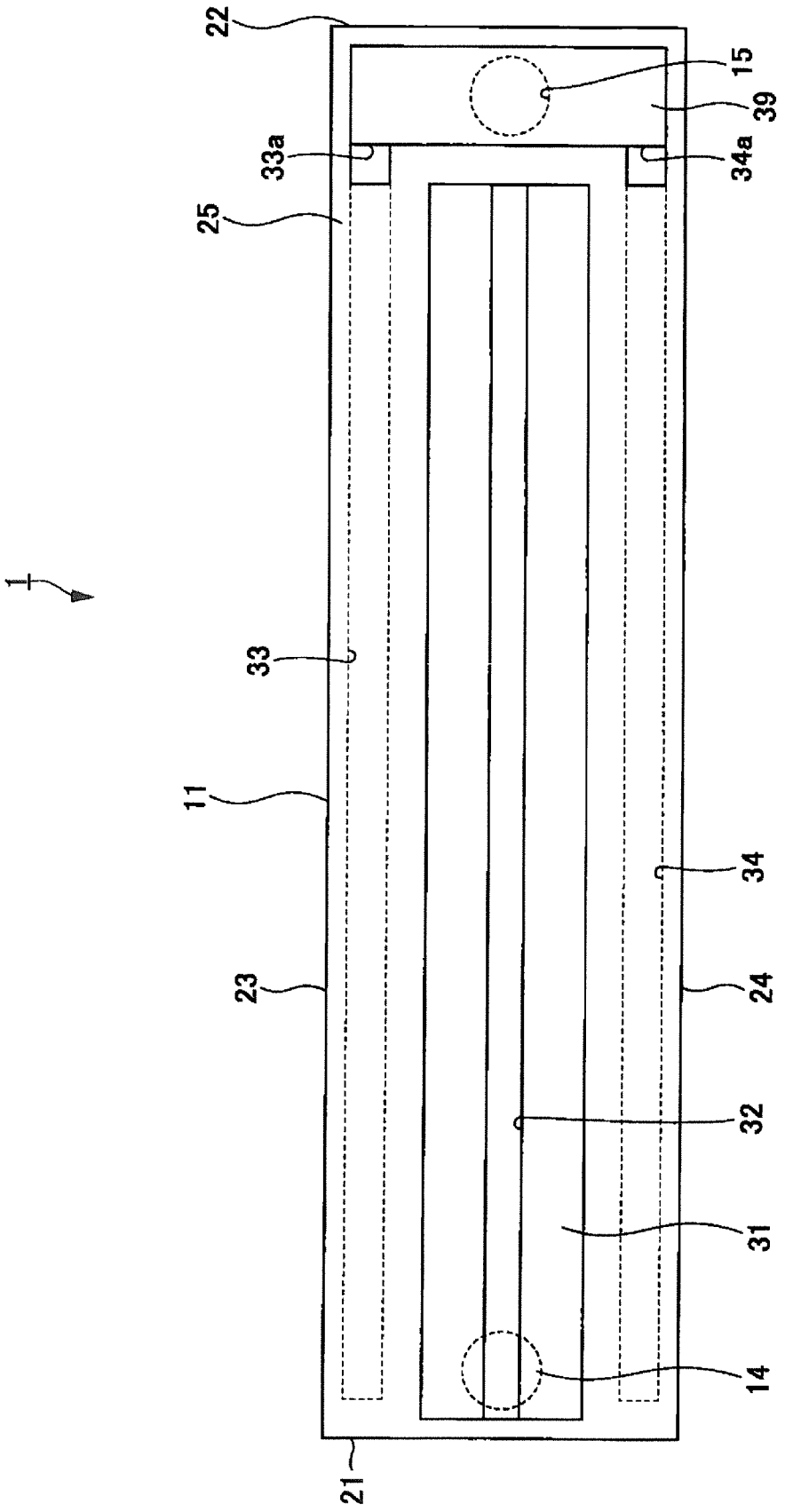


FIG. 5

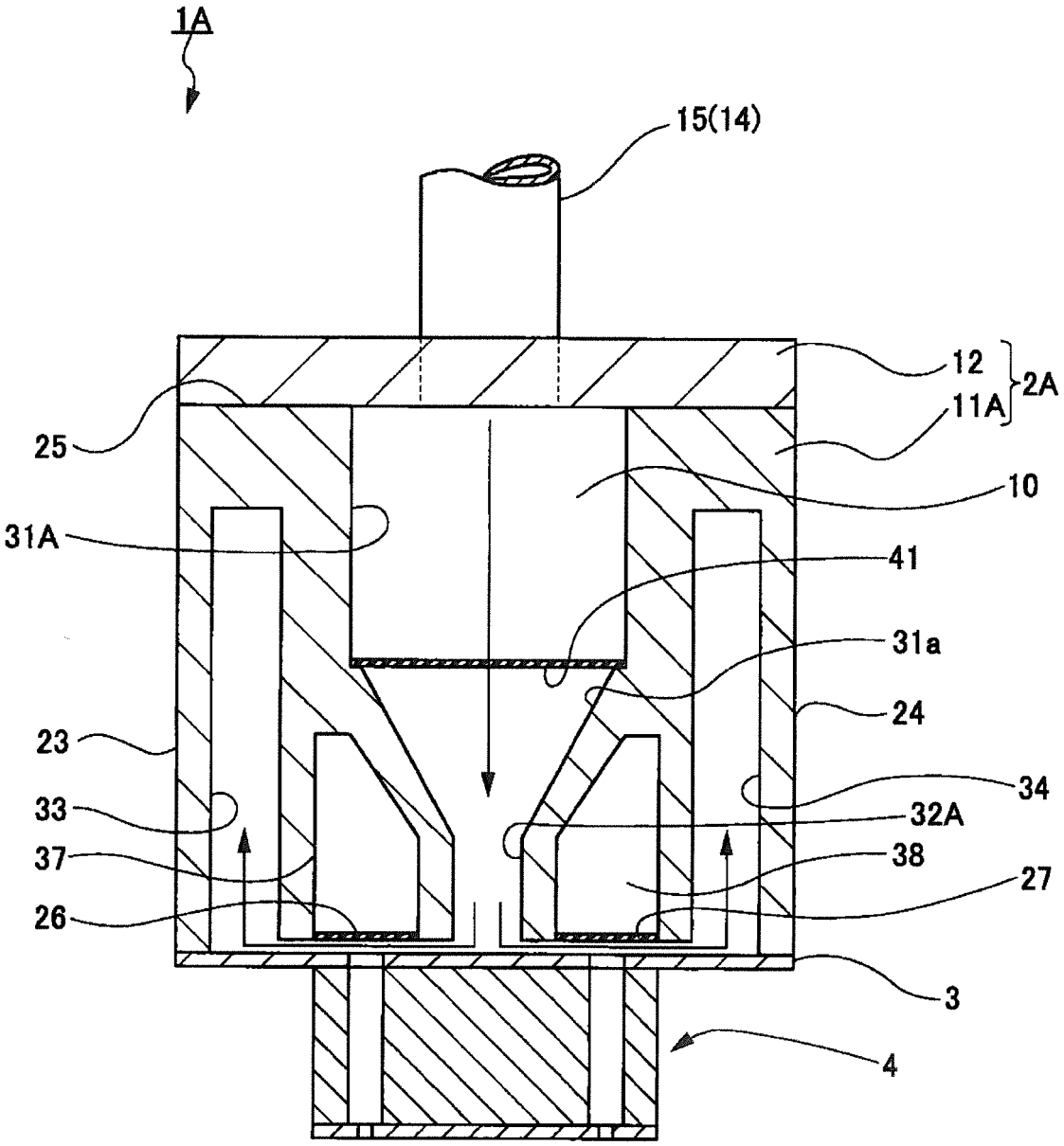
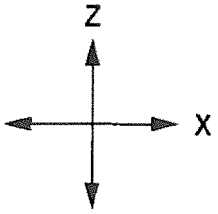
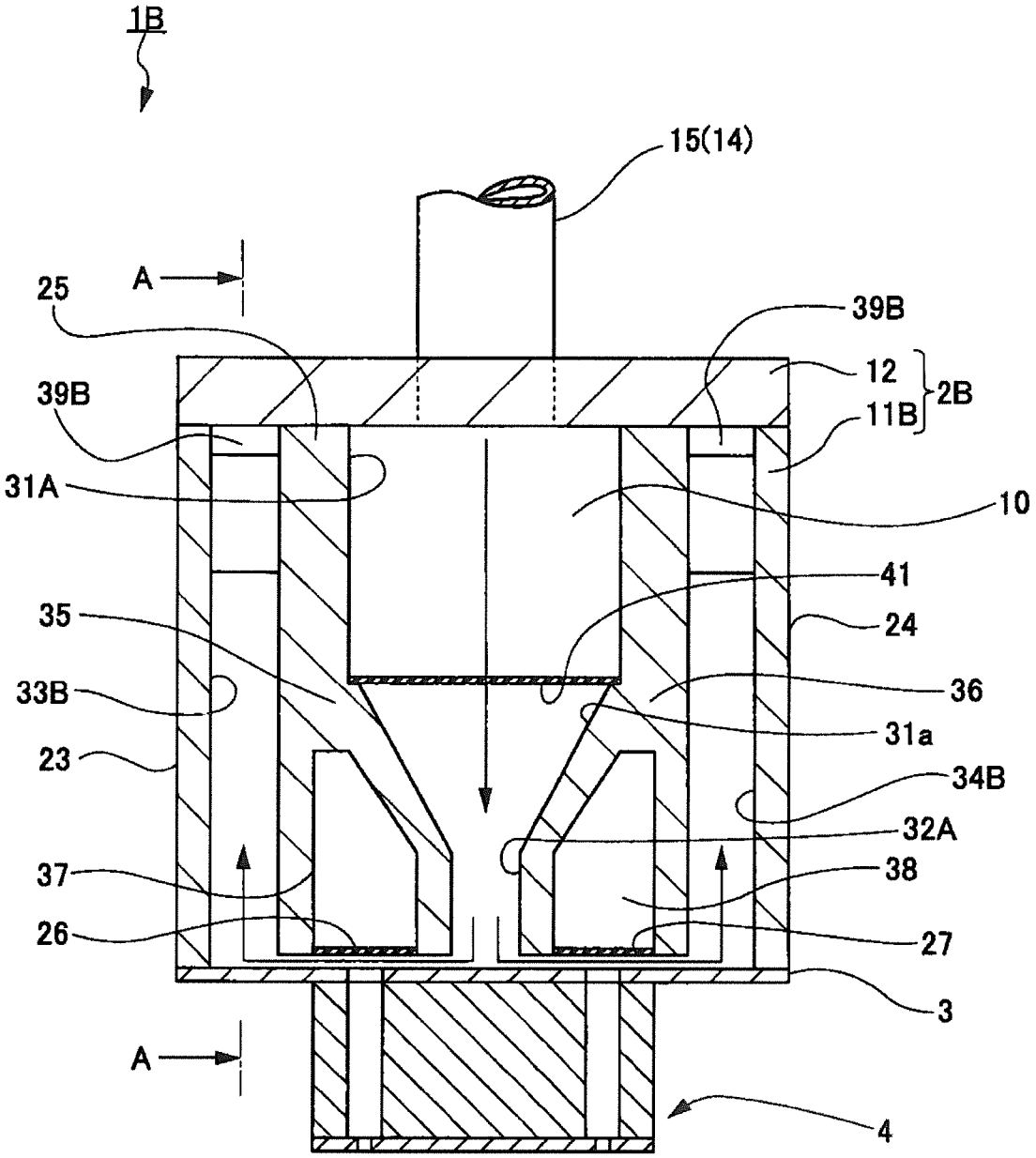


FIG. 6




1B
15(14)
A
25
39B
12
2B
11B
39B
31A
10
41
35
24
33B
36
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23
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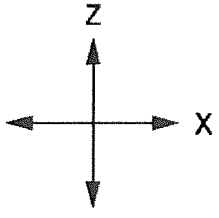
32A
37
38
26
27
3
A
4

FIG. 7


Z
X

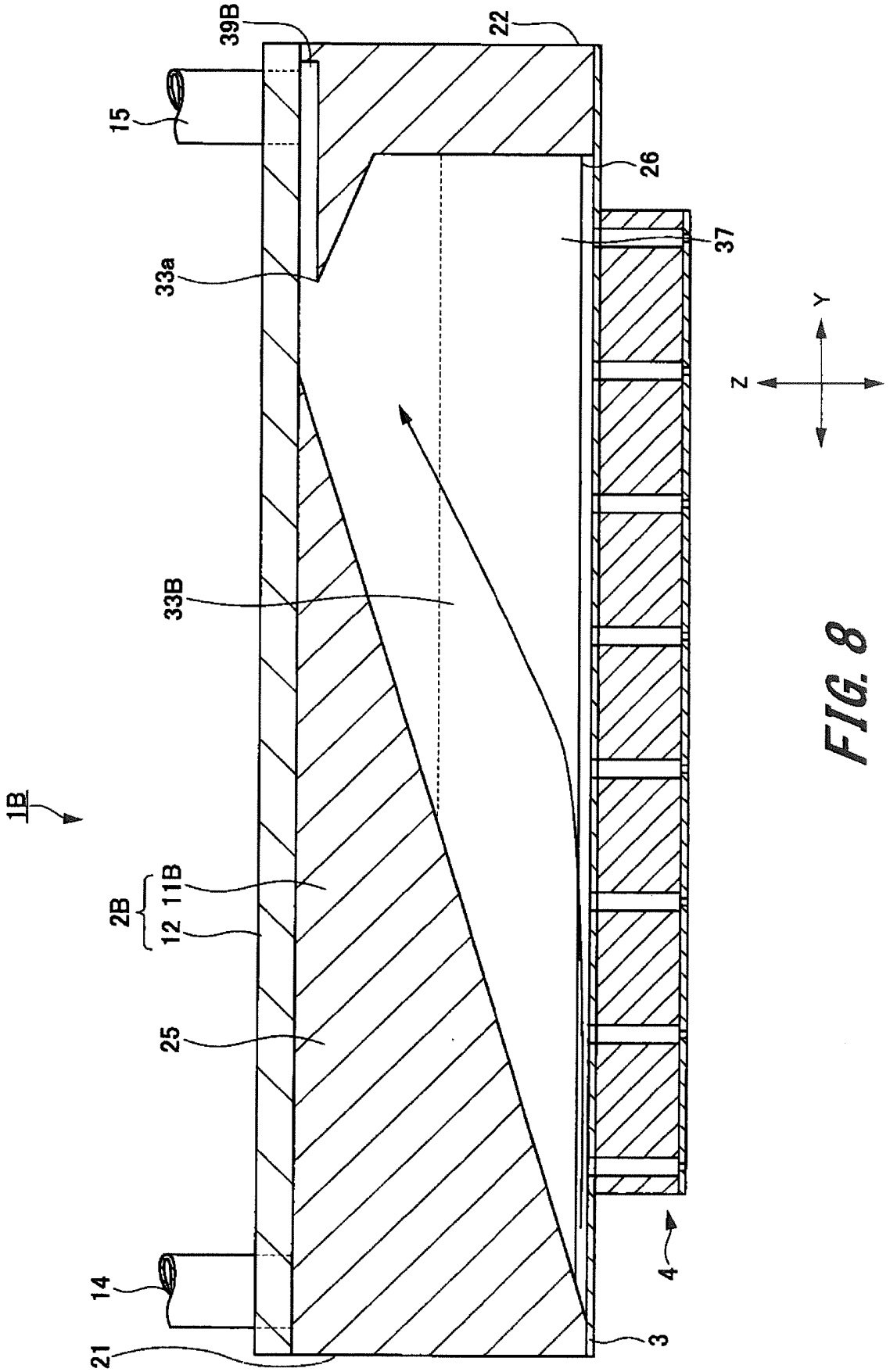


FIG. 8

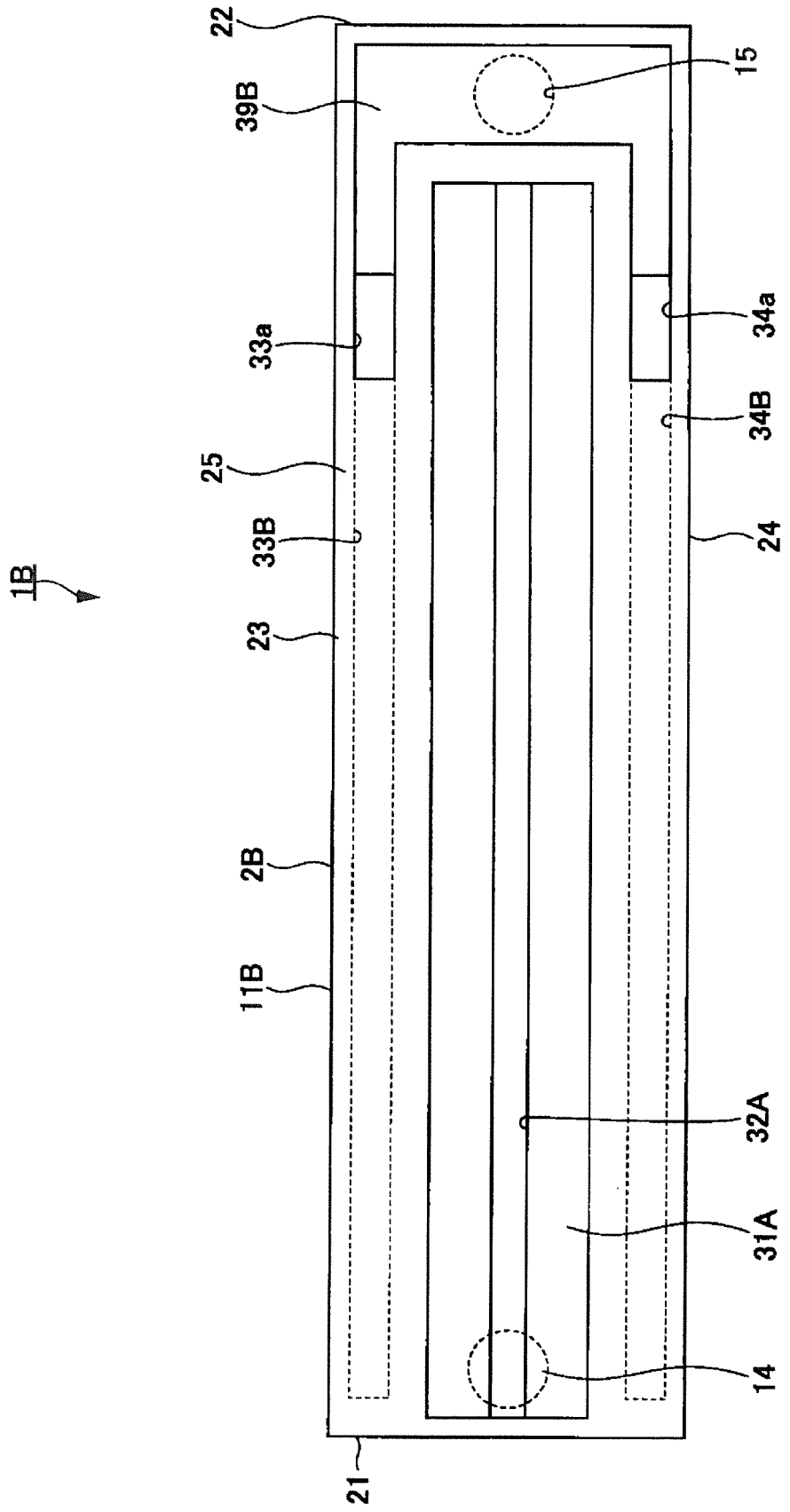


FIG. 9

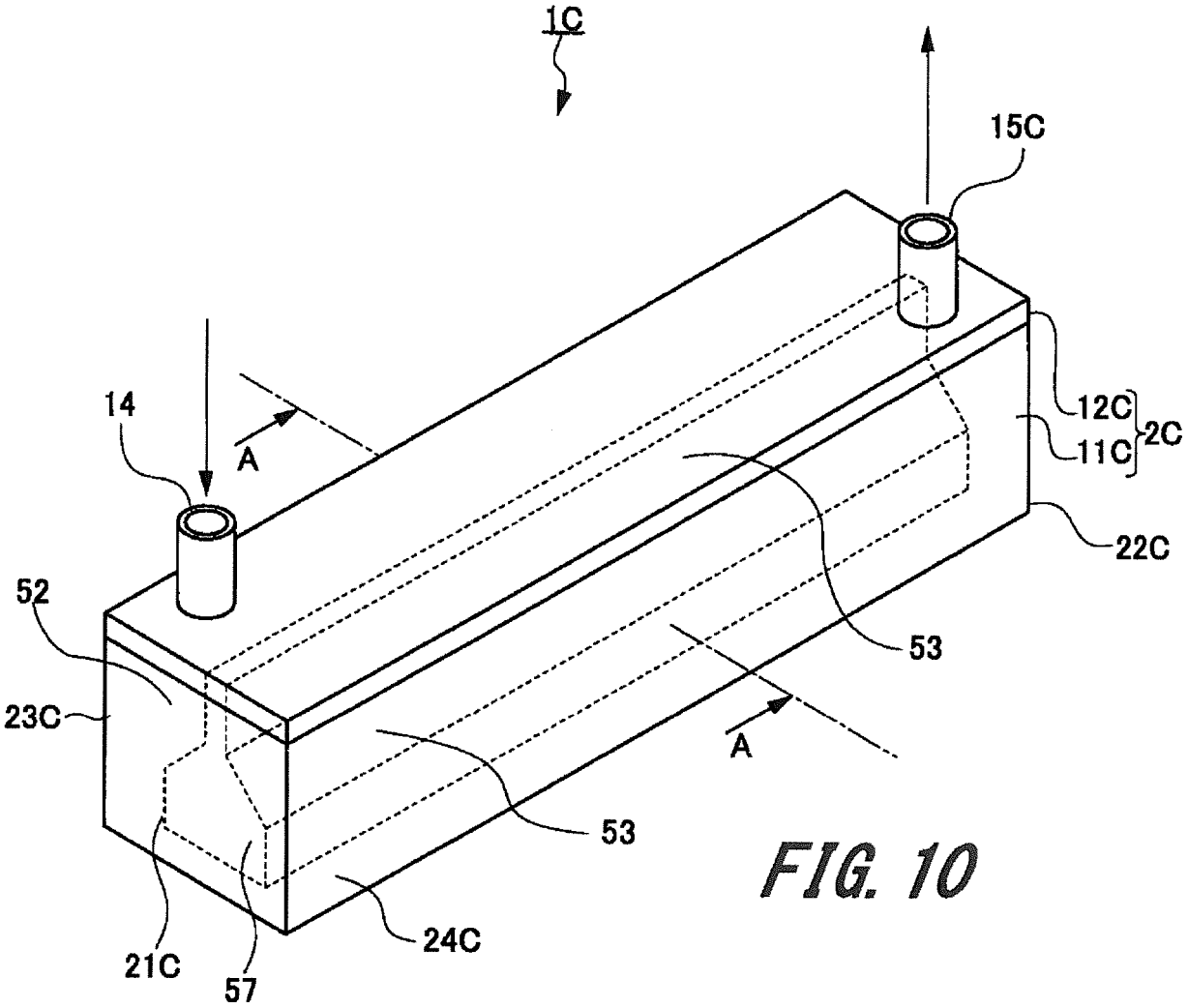


FIG. 10

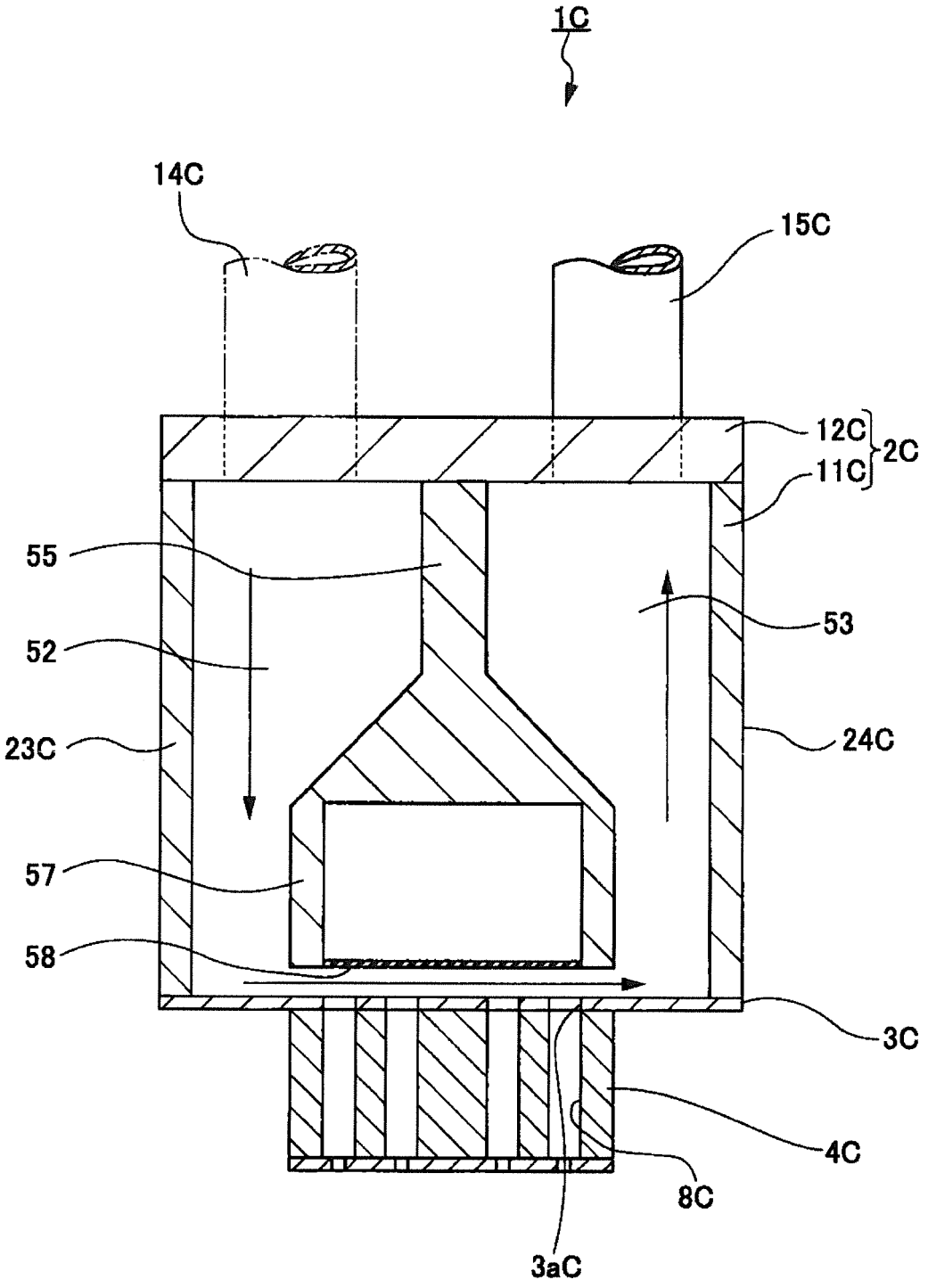


FIG. 11

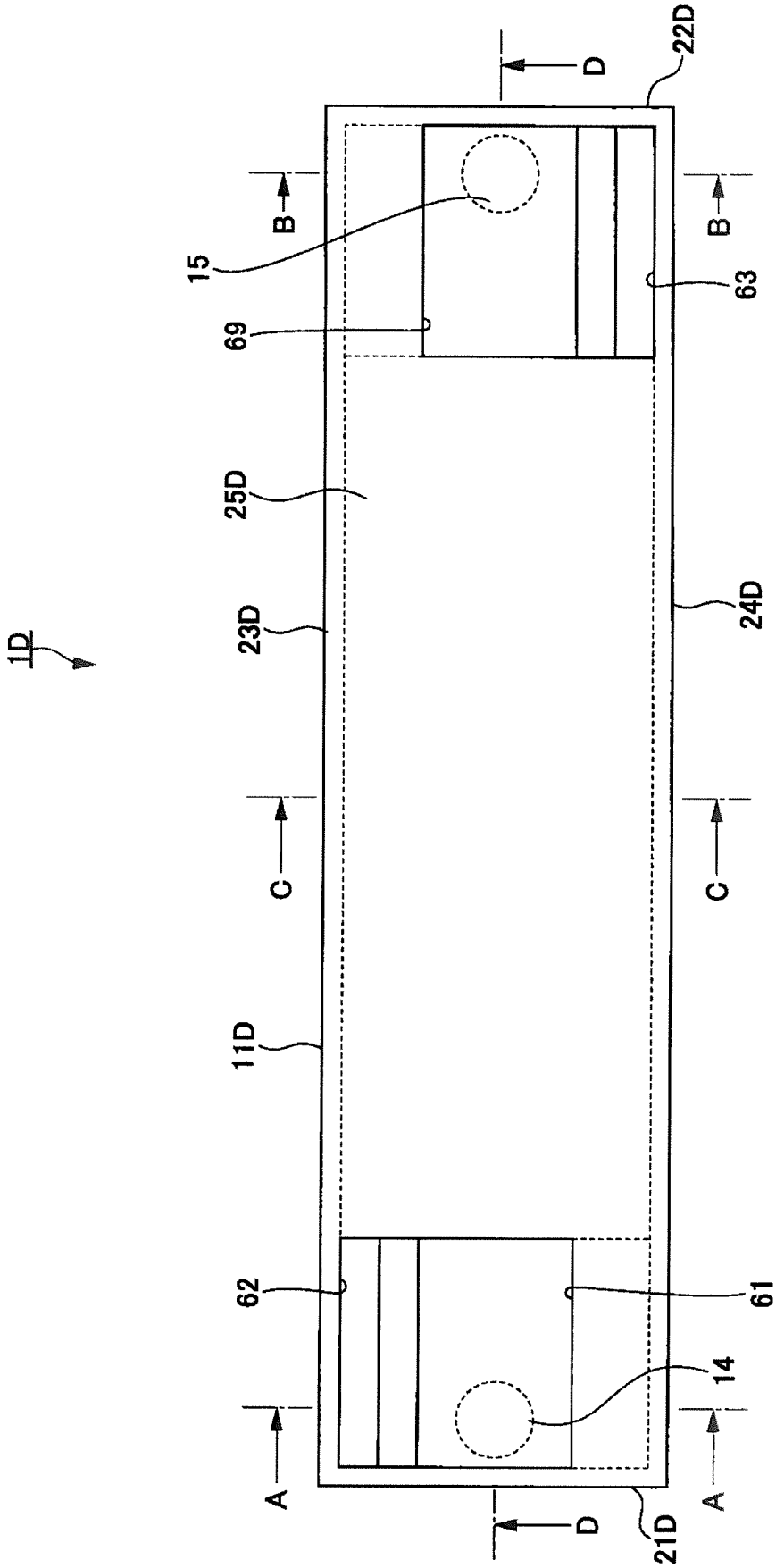


FIG. 12

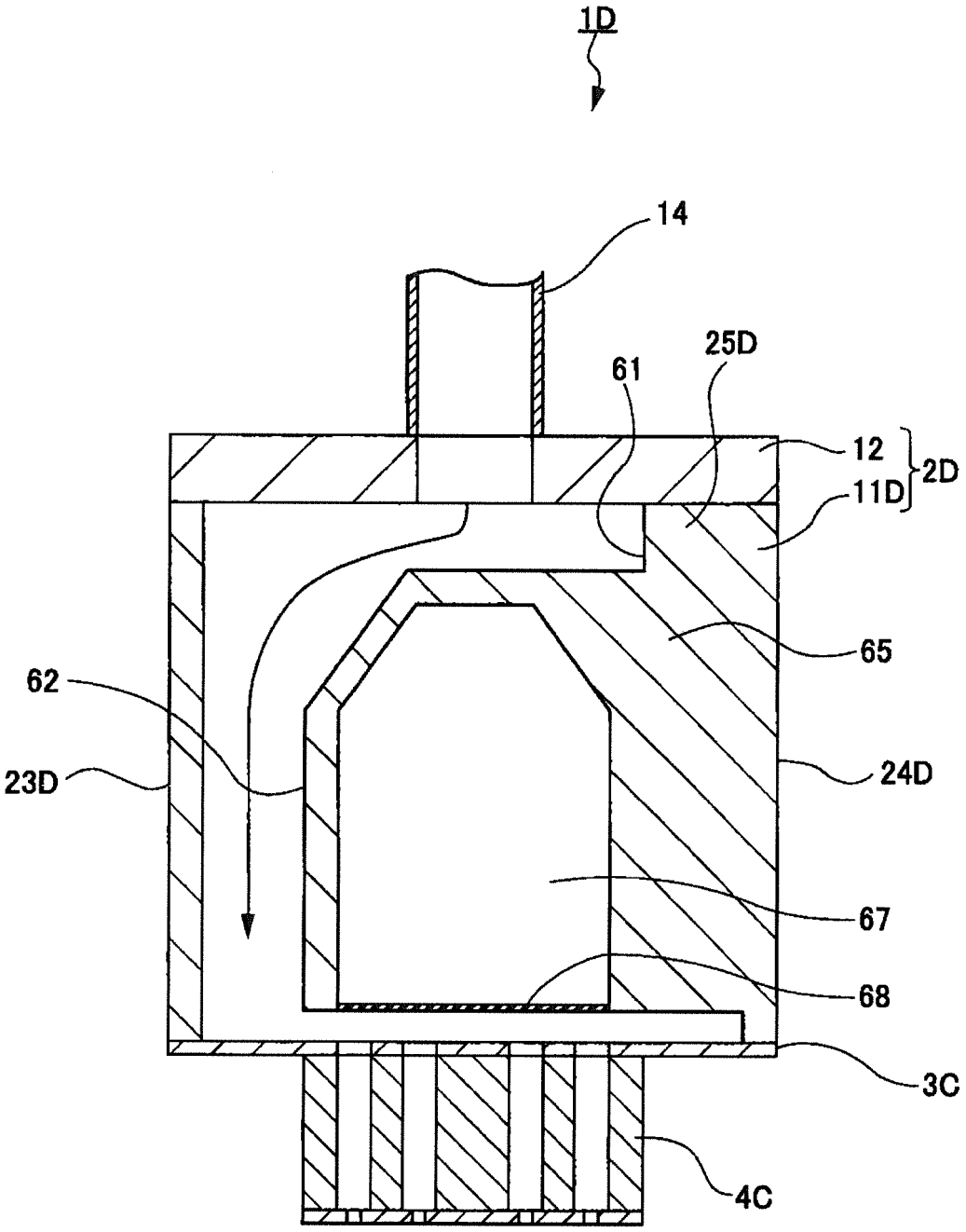
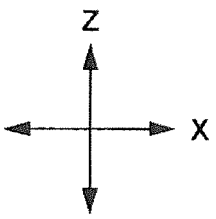


FIG. 13



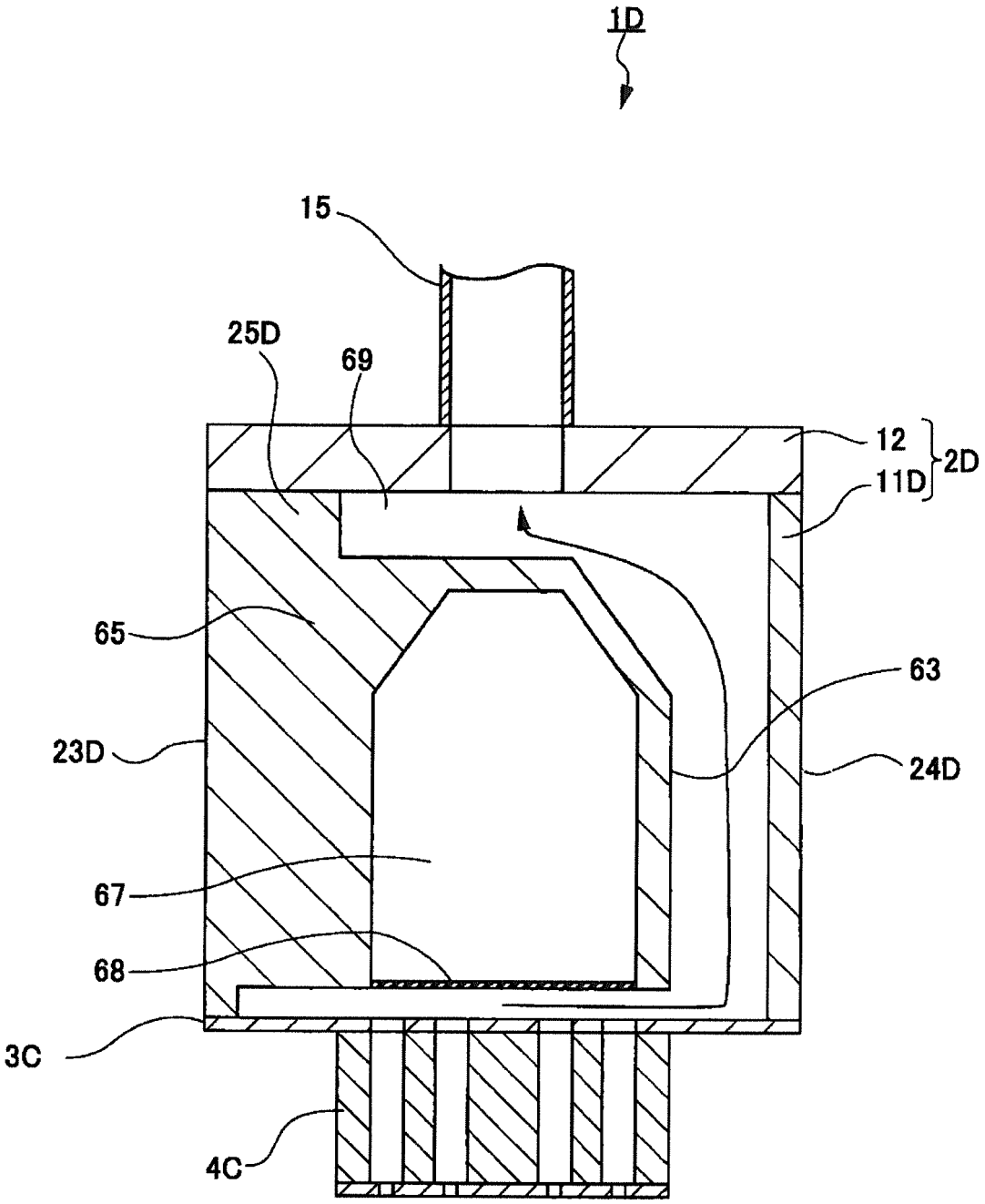
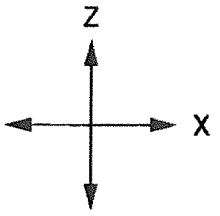


FIG. 14



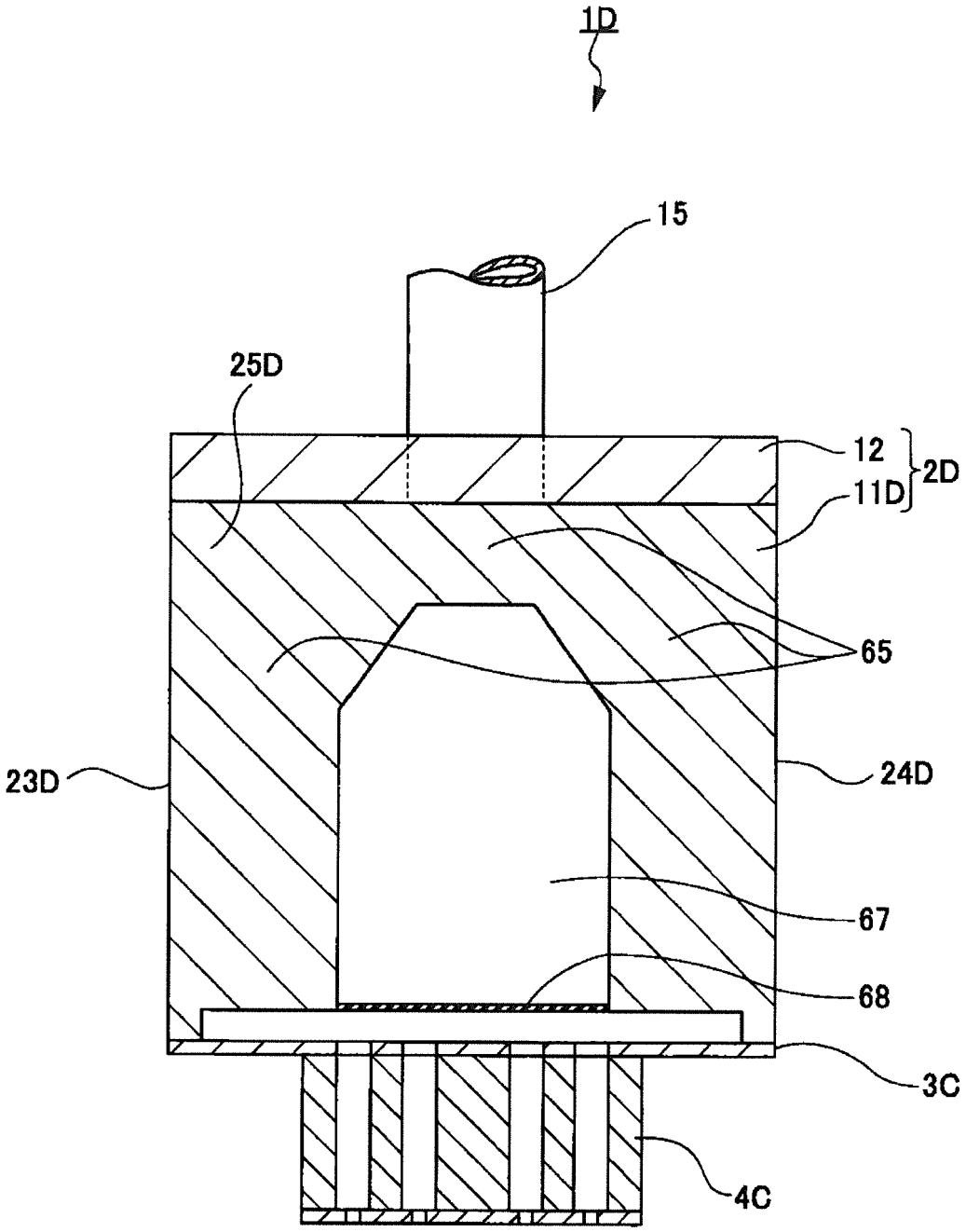
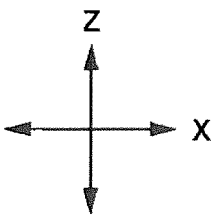


FIG. 15



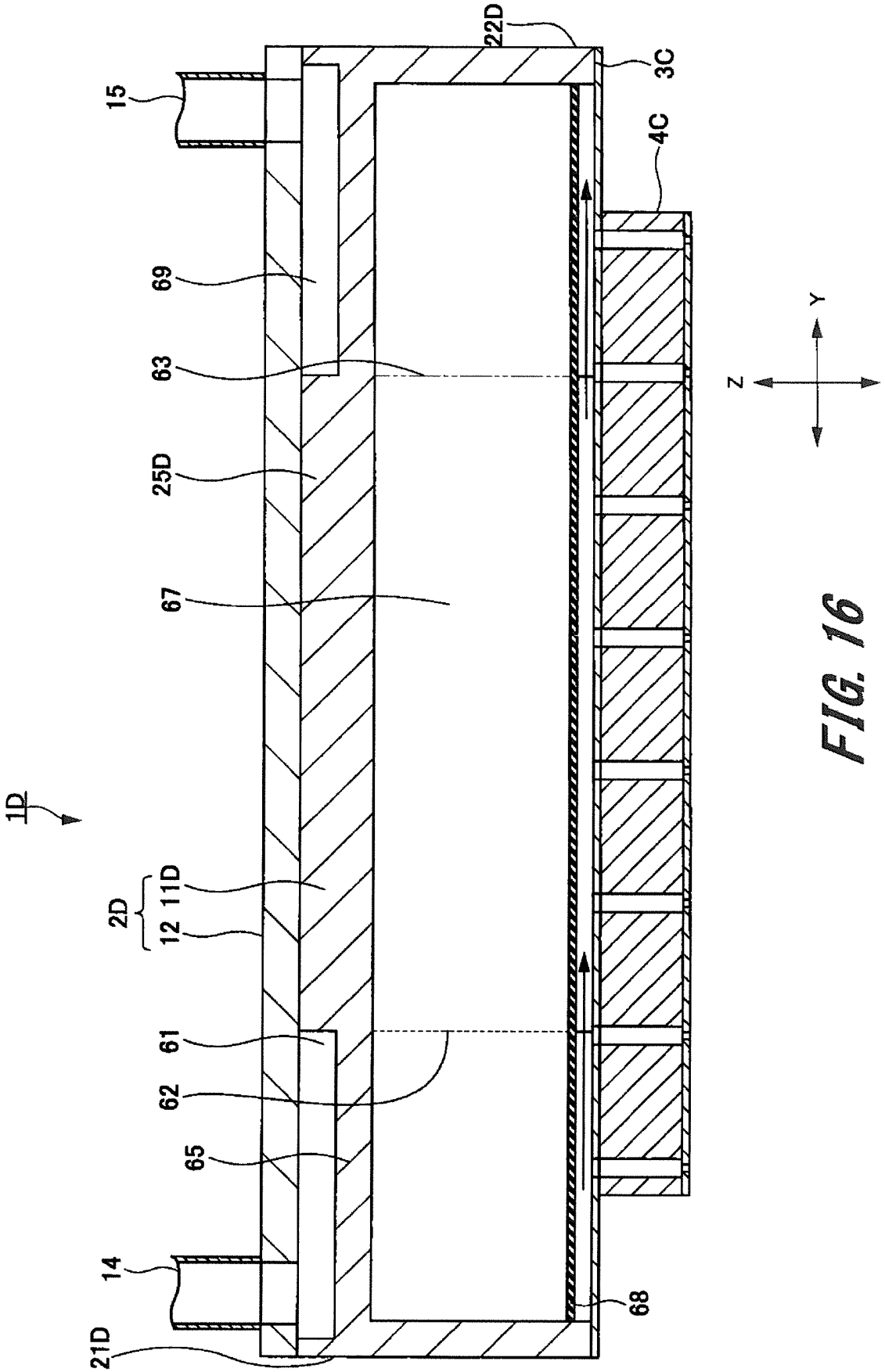


FIG. 16

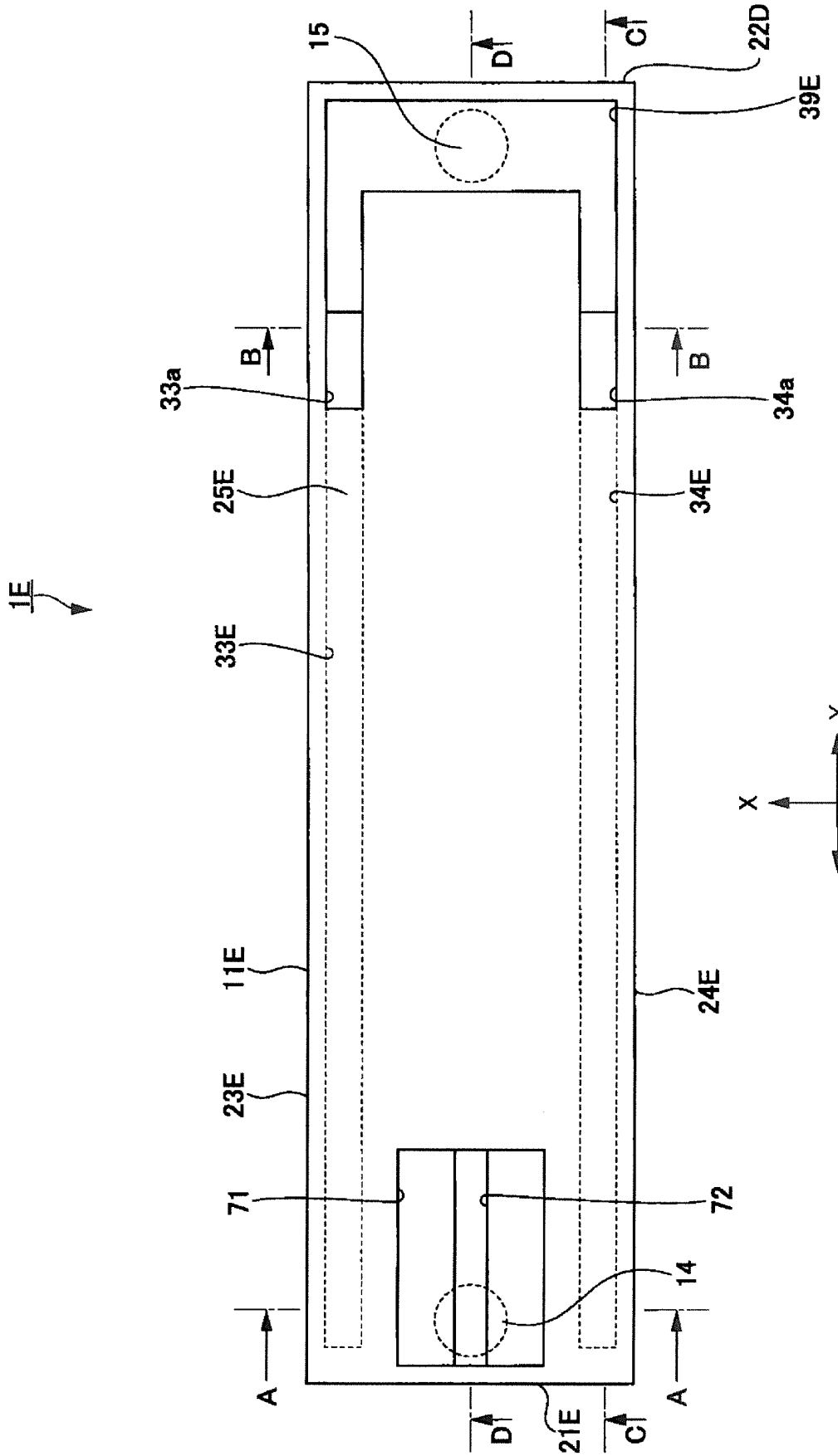


FIG. 17

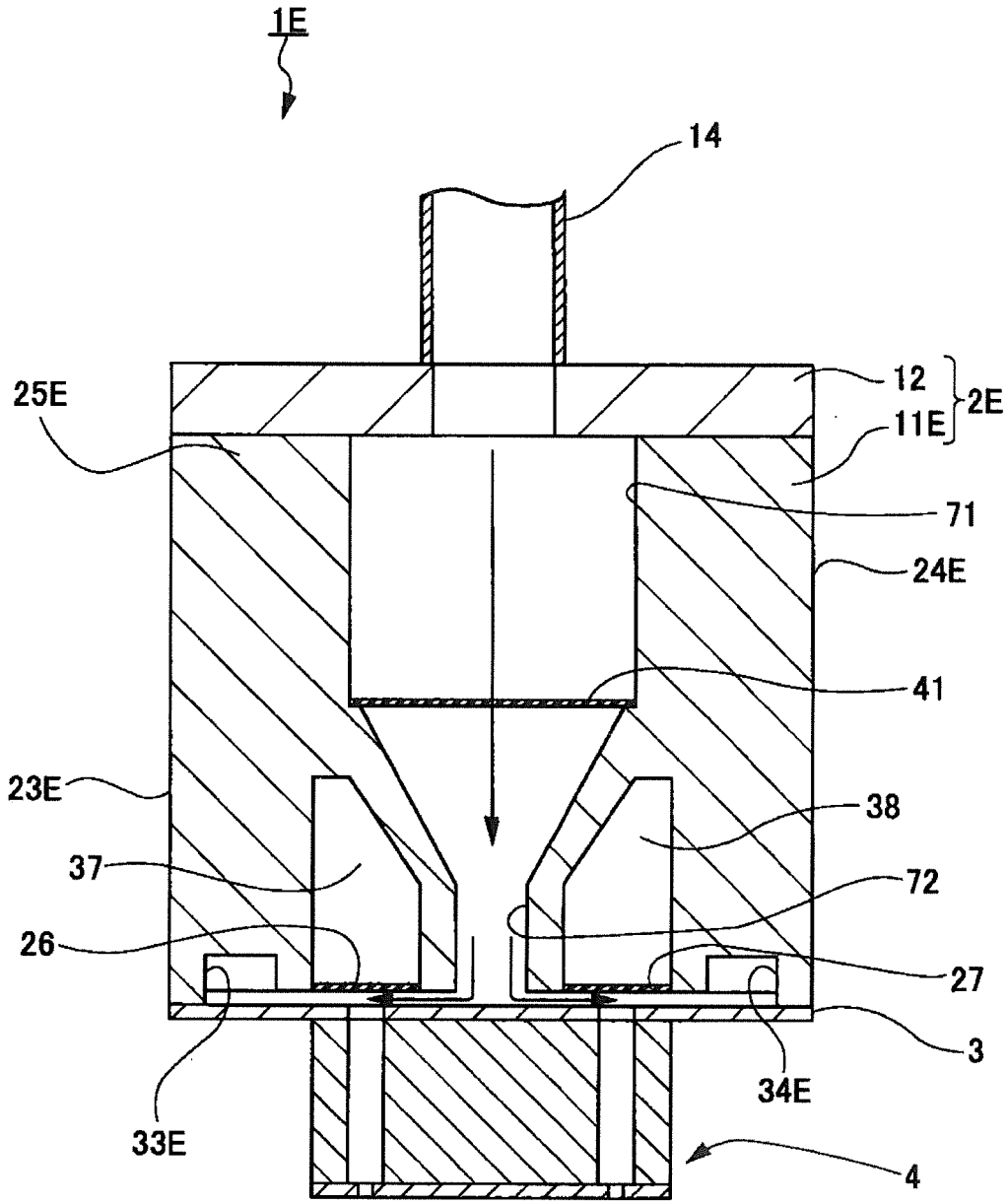
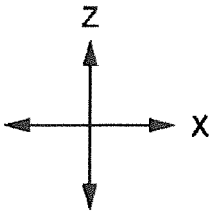


FIG. 18



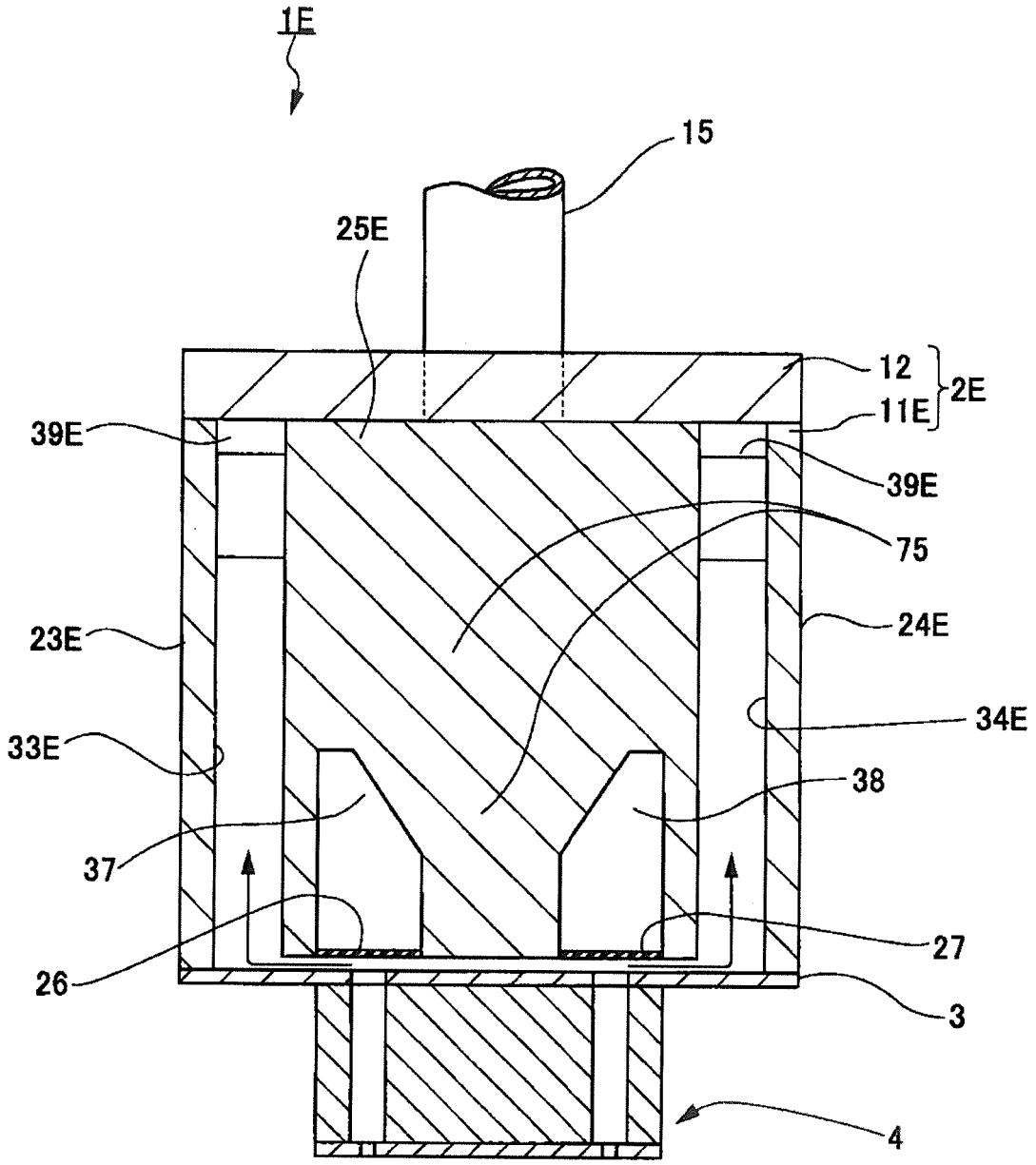
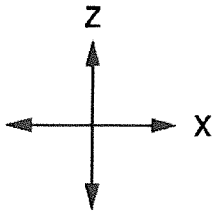


FIG. 19



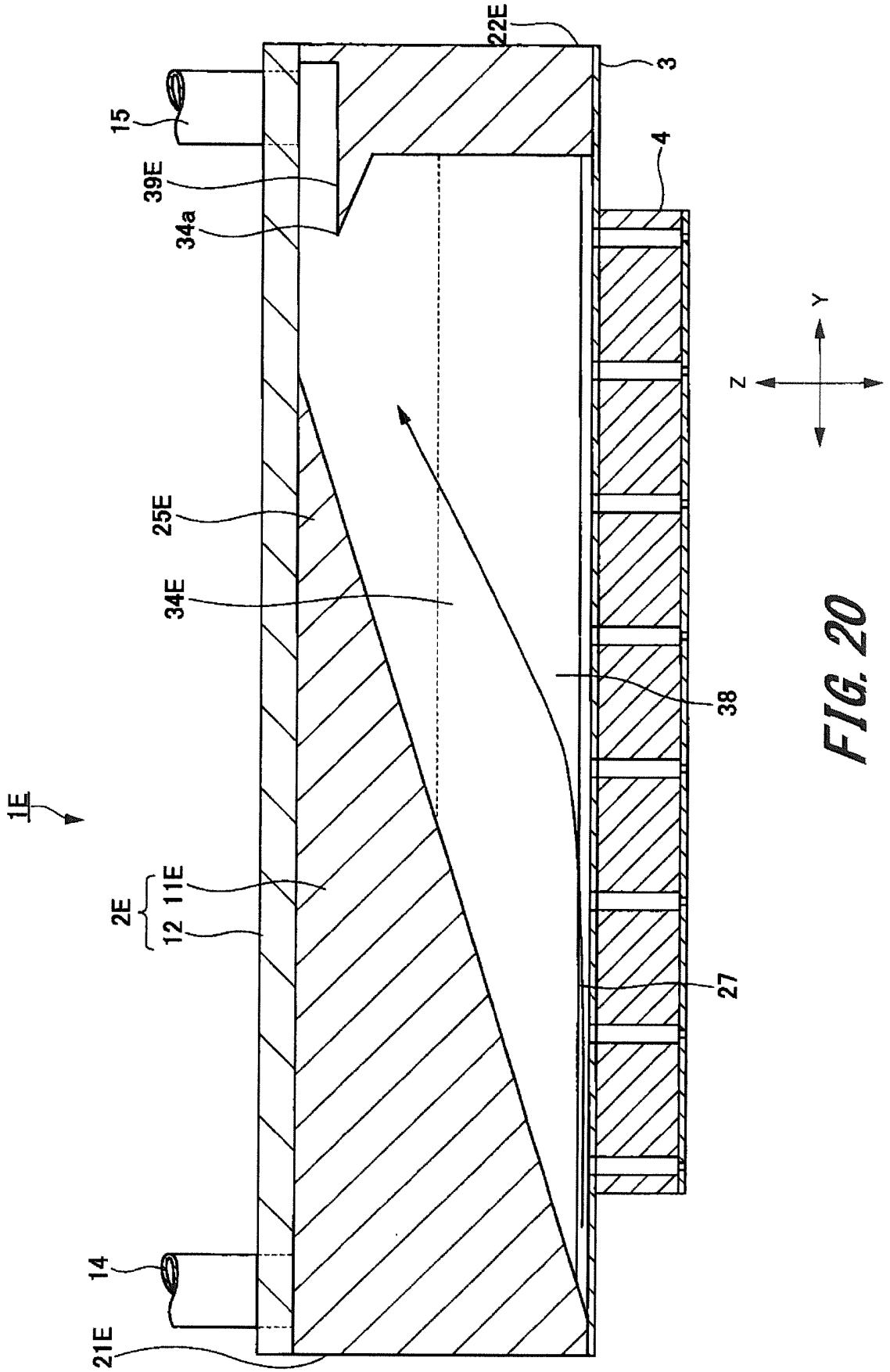


FIG. 20

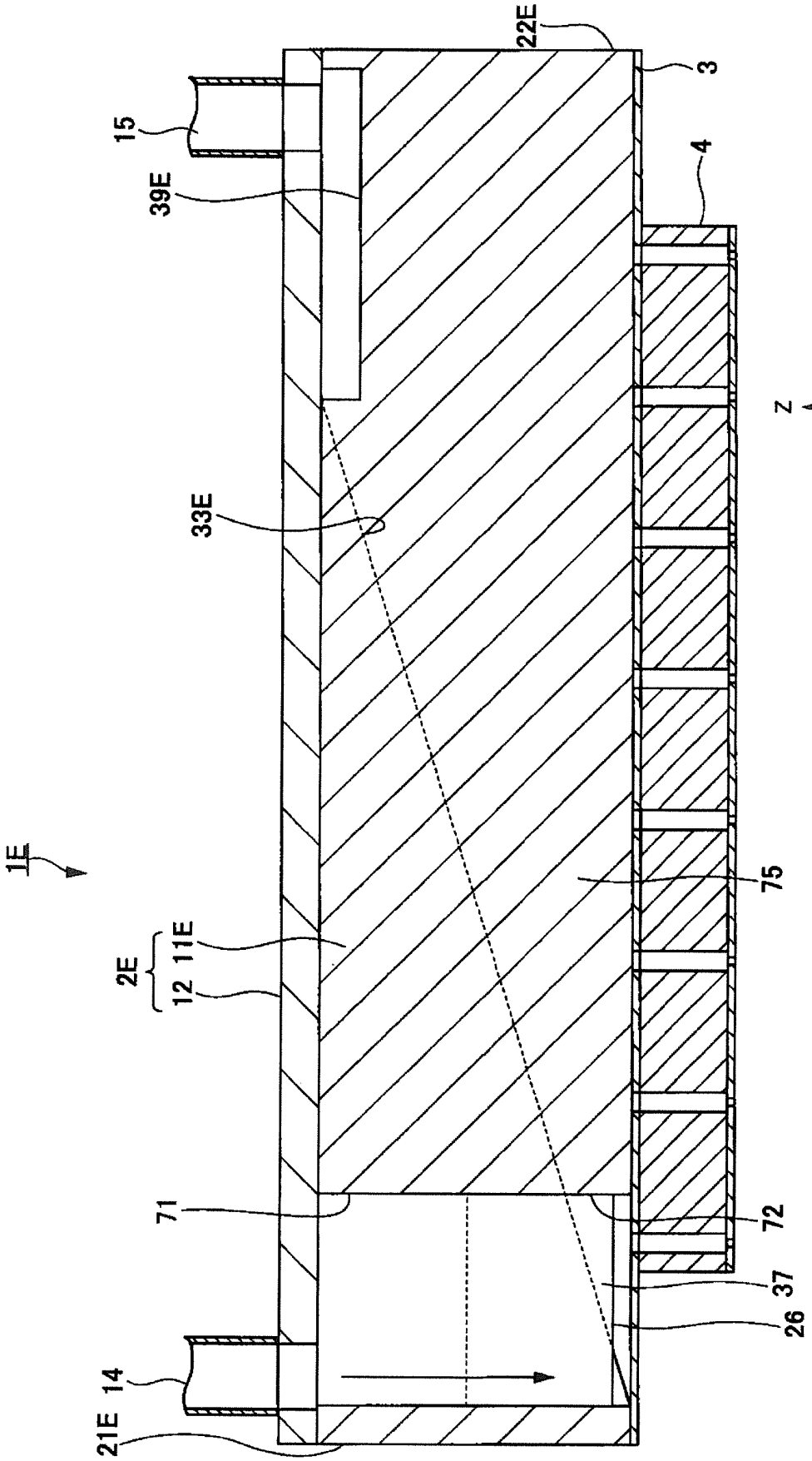


FIG. 21

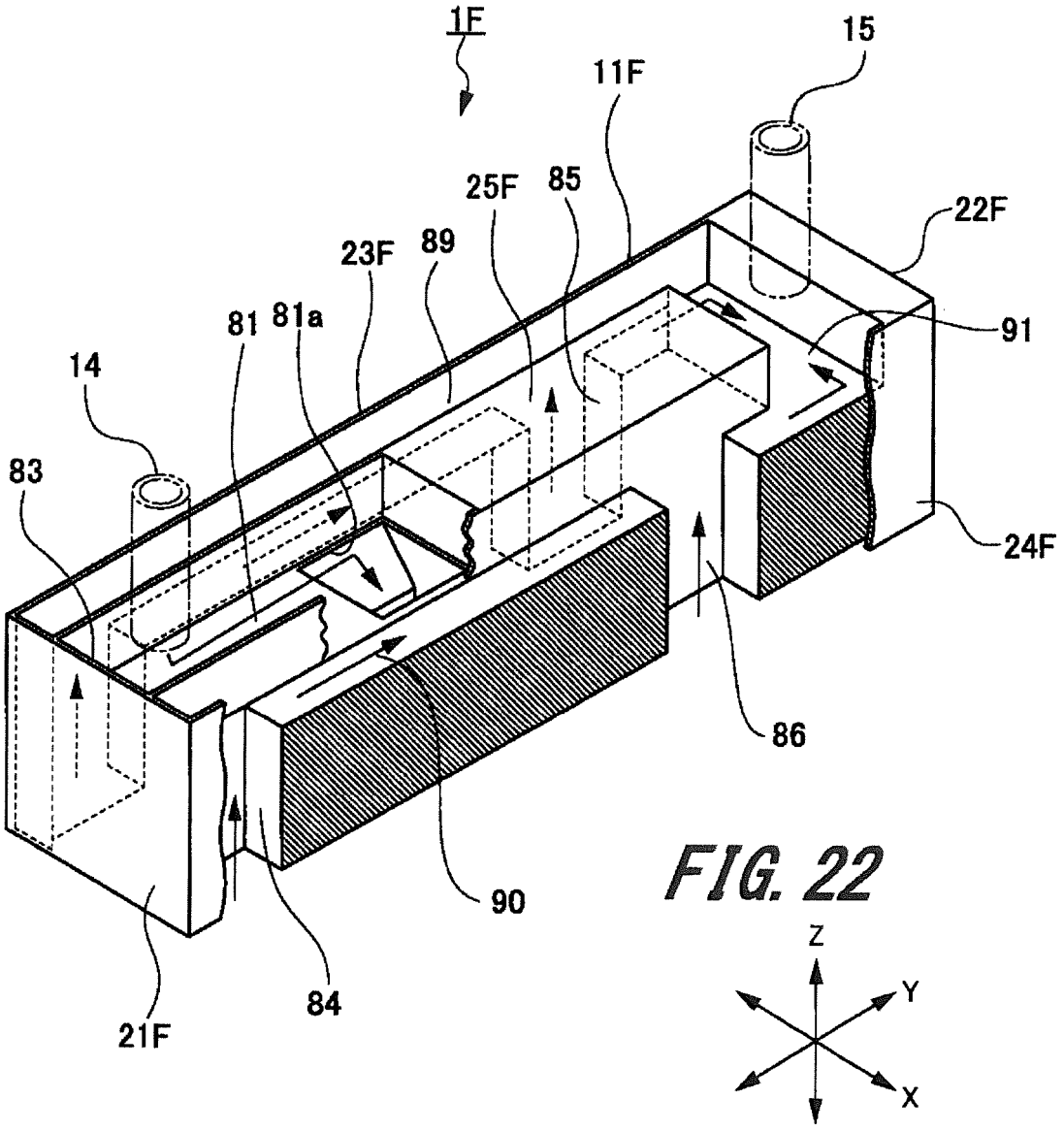
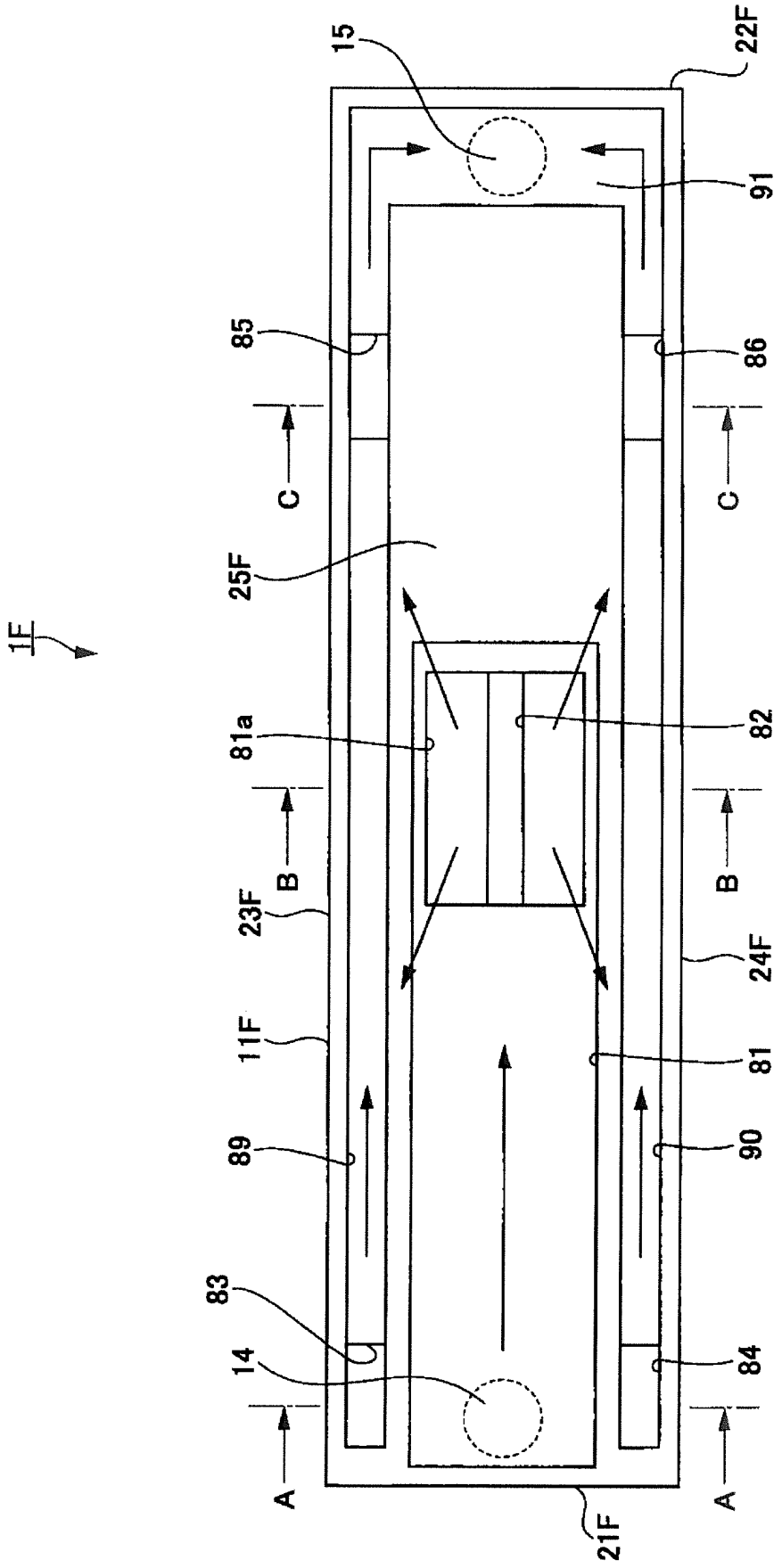


FIG. 22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15
22F
91
85
86
C
C
25F
81a
82
B
B
23F
24F
11F
81
89
90
83
14
84
A
A
21F
Y
X

FIG. 23

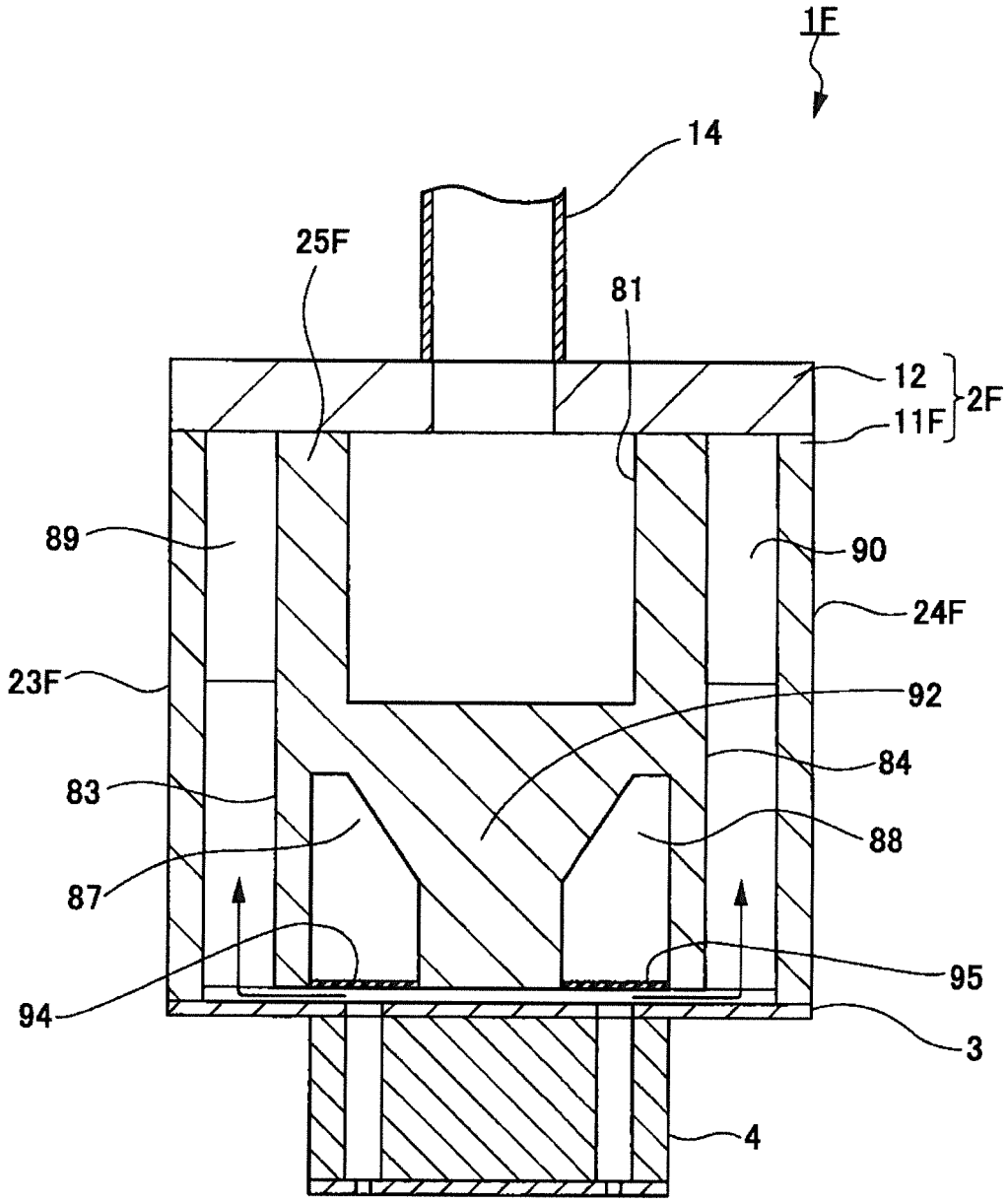
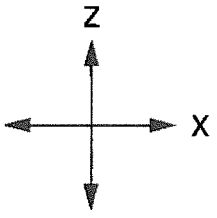


FIG. 24



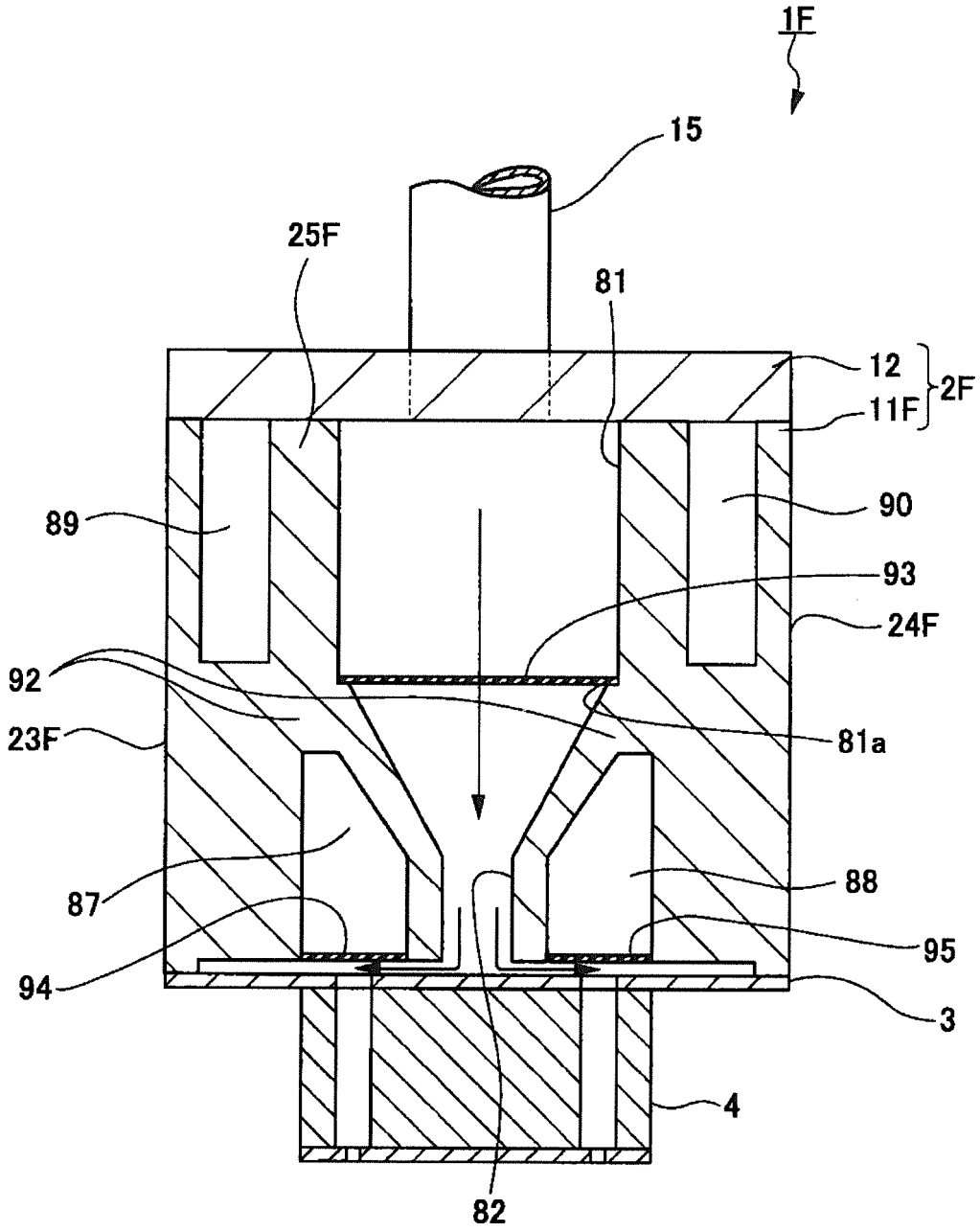
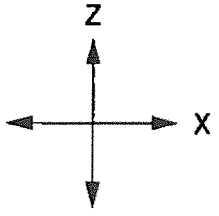


FIG. 25



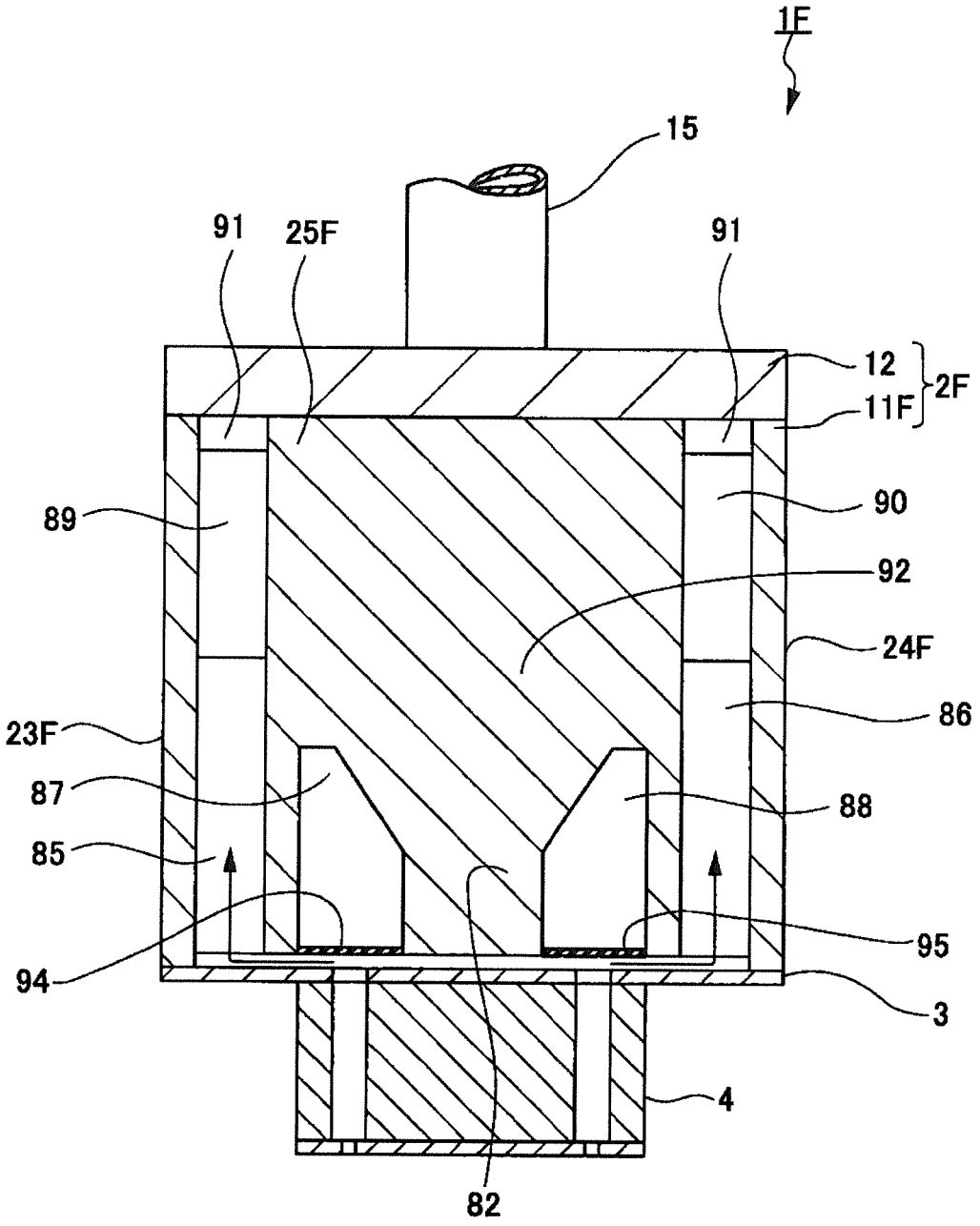
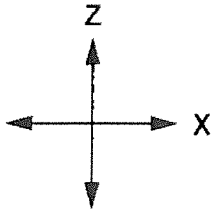


FIG. 26



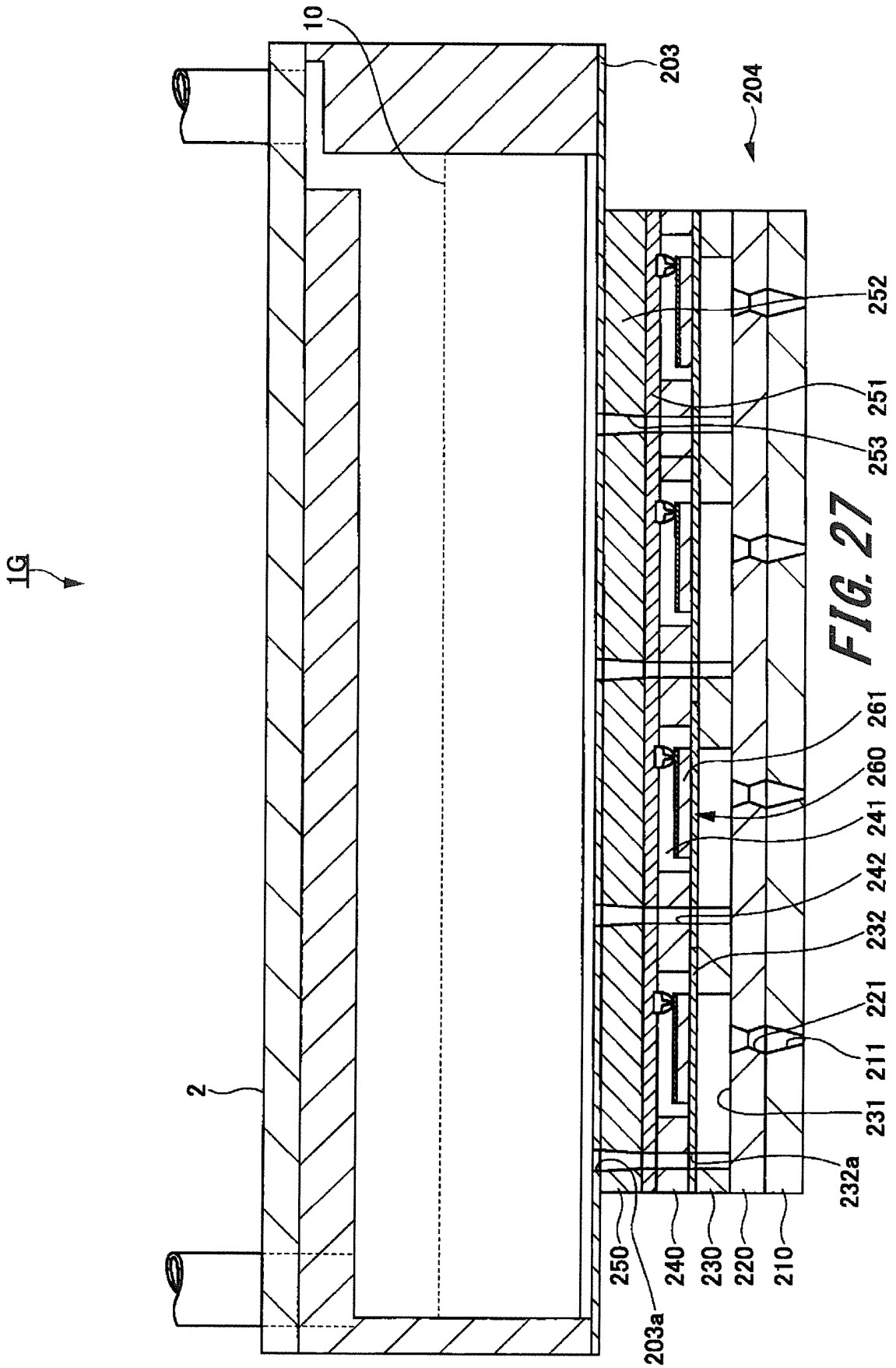

1G
10
203
204
252
251
253
261
260
241
242
232
221
211
231
232a
2
250
240
230
220
210
203a

FIG. 27

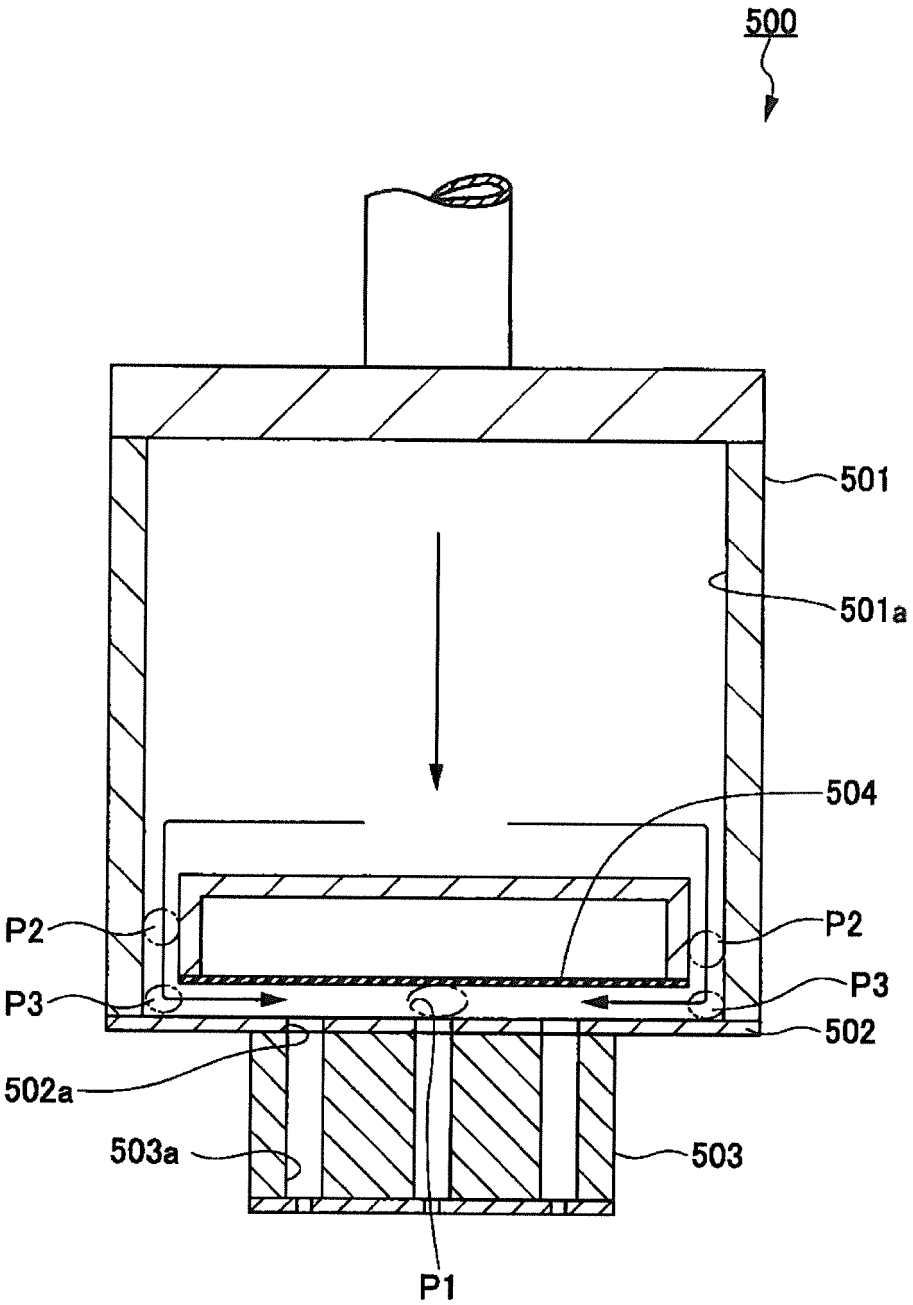


FIG. 28

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2017/034502

A. CLASSIFICATION OF SUBJECT MATTER
B41J2/14(2006.01)i, *B41J2/175*(2006.01)i, *B41J2/18*(2006.01)i, *B41J2/19*(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B41J2/14, B41J2/175, B41J2/18, B41J2/19

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2017
Kokai Jitsuyo Shinan Koho 1971-2017 Toroku Jitsuyo Shinan Koho 1994-2017

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	JP 2014-8696 A (Ricoh Co., Ltd.), 20 January 2014 (20.01.2014), paragraphs [0014] to [0042]; fig. 1 to 6 (Family: none)	1-2,7-10 3-6
Y A	JP 2015-202671 A (Ricoh Co., Ltd.), 16 November 2015 (16.11.2015), paragraph [0057]; fig. 12 (Family: none)	1-2,7-10 3-6
Y	JP 9-187934 A (Canon Inc.), 22 July 1997 (22.07.1997), paragraphs [0002] to [0006]; fig. 5 to 7 (Family: none)	9

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
02 November 2017 (02.11.17)	14 November 2017 (14.11.17)
Name and mailing address of the ISA/ Japan Patent Office 3-4-3,Kasumigaseki,Chiyoda-ku, Tokyo 100-8915,Japan	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2017/034502

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2015-107633 A (Ricoh Co., Ltd.), 11 June 2015 (11.06.2015), entire text; all drawings (Family: none)	1-10
A	JP 2016-22700 A (SII Printek Inc.), 08 February 2016 (08.02.2016), entire text; all drawings (Family: none)	1-10
A	JP 2009-226942 A (Ricoh Co., Ltd.), 08 October 2009 (08.10.2009), entire text; all drawings (Family: none)	1-10
A	WO 2015/182387 A1 (Konica Minolta, Inc.), 03 December 2015 (03.12.2015), entire text; all drawings (Family: none)	1-10
A	US 2008/0204520 A1 (KARLINSKI et al.), 28 August 2008 (28.08.2008), entire text; all drawings & WO 2007/031995 A1	1-10

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2015223737 A **[0008]**